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Criteria Document for Endrin

Environmental Protection Agency

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CRITERIA DOCUMENTS FOR TOXIC POLLUTANTS

Scientific rationale and criteria developed pursuant to Section 307(a) of the Federal Water Pollution Control Act, P.L. 92-500, 33 U.S.C. §§ 1251 et seq., (1972), for the development and establishment of effluent limitations for toxic substances are set forth in the following chapters.

Section 307(a)(2) states inter alia that a proposed effluent standard "...shall take into account the toxicity of the pollutant, its persistence, degradability, the usual or potential presence of the affected organisms in any water, the importance of the affected organisms and the nature and extent of the effect of the toxic pollutant on such organisms..." Thereafter, having considered these factors, the Administrator is to set an effluent standard for toxic pollutants which provides an ample margin of safety.

In the development of criteria which serve as both the basis and the goal for the establishment of effluent limits, reliance was placed on the toxicity data derived from laboratory studies on a range of organisms including invertebrate, vertebrate, and mammalian test species. These studies provided extensive acute and chronic toxicity data based on feeding experiments for a wide range of aquatic organisms and consumers of aquatic organisms. Environmental studies documenting bioaccumulation in the food web of the toxic material by the food chain organisms and bioconcentration by organisms directly from water provided an important component data base upon which criteria were derived. Appropriate human toxicity data and mammalian carcinogenic studies, where available, were used also in developing criteria.

Aquatic toxicity data generally are obtained by one of two basic methods, the static and flow-through bioassay. The more traditional static bioassay employs a tank in which the test organisms are living and to which a given concentraction of toxicant is added. Any water loss due to evaporation is made up by the addition of fresh water. The flow-through bioassay, which is a more recent development, reflects more nearly the natural conditions. Concentrations of toxic substances are constantly maintained and provide a more accurate test of sensitivity of aquatic species. Water in a flow-through test is replenished constantly through flushing. Comparative results using the static and flow-through bioassays demonstrate that flow-through data yield lower toxicity values for a pollutant than a static bioassay. This fact is demonstrated by comparative studies as discussed in the endrin document. However, most of the data available were developed using static bioassays.

Some toxic pollutants are extremely stable and degrade only slowly or form persistent degradation products. Those pollutants which degrade rapidly pose a less severe long-term hazard unless their entry to the environment is continuous. A parent compound, e.g., aldrin, may rapidly degrade or be altered to a more toxic form, i.e., dieldrin.

Bioconcentration of toxic pollutants is a significant consideration in the development of criterion. The rate and degree of accumulation in an animal and the rate of loss from the animal are factors that help define the potential magnitude of the pollution load problem. As an

example, a pollutant which bioaccumulates presents a hazard both to aquatic systems and potentially to man or other carnivores associated with the ecosystem. To satisfactorily manage a persistent or non-degradable pollutant requires the maintenance of a ceiling for ambient levels in water which will afford protection to the food chain and the consumers of aquatic life (animals including humans). The body burden of toxic pollutants in fish or food chain organisms may have no outward effect on the species but will affect consumers of that food level. As an example, the brown pelican, when feeding on endrin-contaminated fish may die or suffer species depletion through reproductive impairment.

Data on toxic effects of pollutants are not available for all species that may be exposed to the toxic pollutant in these complex societies. Such data would be necessary to ensure protection of the most sensitive species. It is desirable to know the relative sensitivity of a wide variety of species in order to have a better estimate of the sensitivity of the untested, most sensitive species. Because such data are not available on all species, the range in sensitivity of a small number of tested species is used to provide a measure of the range of sensitivity of all species.

The natural aquatic environment includes many kinds and life stages of plants and animals that are intricately interrelated to form communities. Criteria are developed to protect these interrelationships and incorporate aquatic toxicity data for a phylogenetic cross section of organisms as well as

species representative of wide geographic distribution. Chronic studies are an important consideration in establishing criteria and require studies of at least one generation, i.e., one reproductive cycle. Use of an application factor for persistent and bioaccumulated toxic pollutants represents consideration of a safety factor. As discussed in the National Academy of Science publication on water quality (p. 185 of the NAS/NAE Water Quality Criteria -- 1972, GPO-5501-00520), the use of an application factor of 0.01 when applied to acute toxic values is thought to provide an ample margin of safety for certain chlorinated hydrocarbon pesticides.

Ecological importance of an organism is dependent on the role the organism plays within the ecosystem and upon its relationship to the food chain within the aquatic community and to consumers of aquatic life, including man. Thus, toxicity data for the top carnivores in a given ecosystem, as well as economically important species such as trout, salmon, menhaden and shrimp are needed for the development of a protective criteria level. Toxicity data for organisms such as the stonefly and Daphnia are of equivalent importance since these organisms are a food base for higher consumers and are representative of invertebrate species found in most waters of the United States.

Invertebrate species, such as the stonefly and the Daphnia, are an indication of the integrity of the aquatic food chain and their presence may be the controlling factor for the abundance of economically and

recreationally important predators such as trout, bass or pike. While these fish may not directly consume the Daphnia or stonefly or, in fact, even inhabit the same waters, these lower order organisms are representative of the food chain base supporting predators.

Criteria levels, by their nature, are developed to protect aquatic organisms and consumers of aquatic life from direct toxic effect when placed on contact with the toxic pollutants; and, to protect from a more insidious and even greater danger, e.g., chronic effects. Chronic effects take the form of reproductive failures or the poisoning of predators consuming food organisms which have bioaccumulated levels of toxic pollutants as in the case of the brown pelican and consuming endrin loaded fish (see Attachment D, Endrin), and a variety of other physiological effects as discussed in the various documents. Decreases in aquatic organisms or consumers of aquatic life not always are coupled to point source discharges of toxic pollutants at concentrations below acute toxic levels; however, the addition of toxic levels which are not acutely toxic can achieve the destruction or at least disruption of aquatic systems by causing reproduction of failure. Hence, the need for application factors. The relationships between discharges of toxic pollutants and effects on important organisms of economic and environmental importance and consumers of these organisms are well documented in the criteria documents.

An approach to criteria development is to provide ample protection of the test species on the assumption that the response of these species will be characteristic of other associated organisms in the aquatic environment. A number of species have been considered in establishing a criteria

Use of mammalian systems to determine the carcinogenic potential of toxicants found in water follows the same principle as use of aquatic organisms to determine toxicity to fish and other organisms. Carcinogenic substances pose a special hazard to man through environmental exposure. Cancer producing substances may reach man by several distinct pathways.

The following four criteria documents for aldrin/dieldrin, DDT and its metabolites, endrin and toxaphene, represent a survey of the scientific literature documenting the effects of these toxic pollutants to aquatic life and consumers of aquatic life including man. A glossary of terms is provided to define the terms used throughout the documents and will be expanded as necessary when additional documents are added.

ENDRIN

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Endrin

I. Preamble

Endrin is a pesticide which has been widely used over the years on cotton and sugarcane crops to control insect pests such as the boll weevil and the sugarcane borer. It has had decreased use in recent years because of the resistance developed by target species, but is still found to be effective for the control of some pests in some areas when used alone or in combination with other pesticides.

Endrin is one of the most toxic substances known for non-target aquatic organisms such as fish and crustaceans and is highly toxic to birds. It has been shown to persist in soil for periods as long as 14 years and to accumulate, especially in fatty tissues, in aquatic food chain organisms. As a result of the data and analysis set forth in this document, the criterion recommended for the prevention of damage from exposure of aquatic life is 0.004 ug/l.

II. Physical/Chemical Properties

Endrin (1,2,3,4,10,10-hexachloro- 6,7, -epoxy- 1,4,4a,5,6,7,8, 8a-octahydro-1,4, -endo, -5,8-endo-dimethanonaphthalene) is one of the chlorinated cyclodiene pesticides. It is an off-white crystalline substance, soluble in non-polar solvents and slightly soluble in water.

Because it is a non-polar compound it apparently forms molecular aggregates of indefinite size in water, with the result that there is no clear line of demarcation between "dissolved" and "suspended" material (1). Thus, any solubility determination is affected by the degree of settling or filtration which precedes analysis for "dissolved" endrin. Richardson and Miller in 1960 (2) reported the solubility of endrin in water as 230, 380, and 510 ug/l at 25°C, 35°C, and 45°C, respectively. The Lower Mississippi River Technical Assistance Project in 1969 (1) found the solubility at 25°C to be 260 ug/l for particles up to .5 microns in diameter and 190 ug/l for particles up to 0.05 microns.

Because of its non-polar structure, endrin dissolves more readily in fats than in water, a property common to organic pesticides which bioaccumulate. Like other non-polar molecules in an aqueous environment, endrin can be strongly adsorbed by particulate matter, a property of considerable importance in its distribution between liquid and solid phases in a receiving water. It has been shown that endrin is resistant to leaching from bottom sediments (3) and from watersheds to which it has been applied (4).

Endrin can undergo rearrangement during prolonged storage to yield a ketone (5). It also undergoes isomerization to ketone and aldehyde forms at temperatures in the vicinity of 200°C (5). Monochromatic ultraviolet light and sunlight can cause the same rearrangement as heat (6,7). Burton and Pollard (6) demonstrated that June sunlight could stimulate the isomerization of 65 percent of the endrin exposed on glass plates. Zabik et al., (7) reported that 80 percent of endrin exposed to ultraviolet light at 253.7 and 300 nm was converted to the half-cage ketone, 1,8-exo-9, 11, 11- pentachloropentacyclo [6.2.1^{3,6} .0^{2,7} .0^{4,10}] dodecan-5-one and stated that this compound has been detected in the field. Asai, et al. (8) showed that

endrin was rapidly decomposed to the ketone and aldehyde forms at 25°C on air-dried soil samples and that the presence of moisture prevented this loss.

The physical properties of endrin are summarized in Table 1.

Table 1

Summary of physical properties of endrin

Property	Description
Empirical formula	$C_{12}H_8OCl_6$
Molecular weight	380.76
Flammability	Nonflammable
Corrosive action	Noncorrosive
Physical state at 68°F.	flowable crystals
Color	off-white to light tan
Odor	mild chemical
Insoluble residue, percent weight	less than 0.5 in xylene
Density, g/cm^3 (20)	1.75
Setting point, °F.	rearranges when heated above 390°F
Bulk density, lbs/cu ft.	55-60
Endrin content, percent by weight minimum (technical grade)	95
Chlorine content	55-57 percent

Free acid (percent by weight)	less than 0.4, calc. as acetic acid
Solubility at 77°F.	
Xylene	3.3 lb/gal. (approx.)
Aliphatic hydrocarbons	low, about 0.1 lb/gal.
Methyl alcohol	sparingly
Water	230 ug/l at 25°C

III. Toxicological Aspects

Toxic effects resulting from the presence of endrin in water have been documented for aquatic organisms representing a wide phylogenetic cross section and geographic distribution. While all test organisms used may not be universally distributed in the waters of the United States, they represent types of organisms present in fresh, marine and estuarine systems throughout the country. Extrapolation from the effects found in laboratory and field tests is a reliable means for predicting effects of endrin on individual organisms and their food chains and is recognized as such by the scientific community.

Bioaccumulation of a toxicant may begin with those organisms forming the bases of food webs, for example mosquito larvae, with subsequent adverse effects on the higher predatory organisms.

Since only a small fraction of the total number of aquatic species can be subjected to toxicological testing and since laboratory conditions dictate the use of organisms suited to captivity, the most sensitive and important

organisms in a given aquatic system may easily escape testing.

Thus, while available data may not represent either the most sensitive or most important sensitive organism at a given geographical location, the data are indicative of predictable toxicological effects in the aquatic environment.

It should be noted that the LC50 values reported for static tests are likely to be substantially higher than LC50 values found using flow-through bioassays. For instance, Earnest in 1970 (13) found a 96-hour TL50 (LC50) of 4.7 ug/l of endrin for Korean shrimp Palaemon macrodactylus using a static bioassay and a TL50 (LC50) of 0.30 ug/l using an intermittent-flow bioassay. This may explain why Katz in 1961 (17) reported a 96-hour TLm of 1.2 ug/l in fresh water for chinook salmon, Oncorhynchus kisutch, while Earnest in 1970 (13) calculated a value of 0.14 ug/l, about one-tenth of the static bioassay value, from freshwater intermittent-flow bioassay data. These data suggest loss of toxicant in static bioassays. Static tests in which dissolved oxygen and toxicant concentrations are measured periodically are

more reliable than those in which these parameters are not monitored. The flow-through bioassays more accurately reflect nature, where "container wall" effects are likely to be negligible and where the volume of water per fish is much greater.

A review of published toxicity values shows that endrin is extremely toxic to many fish (9) and to invertebrate species such as the stoneflies (10) and shrimp (12,41). The daphnids appear less sensitive (11).

Endrin is acutely toxic to birds and mammals (32, 29, 26, 27). Human poisoning resulting from accidental consumption of endrin-contaminated food also has been reported (73).

A. Invertebrates

The stonefly, Pteronarcys californica, appears to be marginally more sensitive to endrin than either Pteronarcella badia or Claassenia sabulosa (10). Sanders and Cope (10) in 1968 reported the 48-hour LC50 value for P. californica as 0.96 ug/l and the 96-hour LC50 as 0.25 ug/l.

The majority of the acute LC50 values for invertebrates ranged between 1.0 and 5.0 ug/l (see Table 2).

Eisler in 1969 found that the 96-hour LC50 values for sand shrimp, Crangon septemspinosa, and grass shrimp, Palaemonetes vulgaris, were 1.7 and 1.8 ug/l, respectively, in static bioassays (12). In intermittent-flow bioassays, Earnest (13) reported the 96-hour TL50 (LC50) values for Korean shrimp, Palaemon macrodactylus to be 0.12 ug/l. Schimmel et al. (41) reported an EC50 value of 0.037 ug/l for the pink shrimp, Penaeus duorarum in flow-through bioassays. In other experiments it was found that a 48-hour EC50 value for P. californica was 1.0 ug/l (14). Finally, Jensen and Gaufin (15) in 1966 determined the 96-hour TLm values for Acroneuria pacifica and P. californica to be 0.32 and 2.4 ug/l, respectively; the 30-day TLm values for these stoneflies were reported to be 0.035 and 1.2 ug/l, respectively, in flow-through bioassays. Short-term toxicity values for a variety of invertebrates are shown in Table 2.

Table 2

Endrin LC50 Data for Invertebrates

Organism	Habitat	Duration		Concentration (ug/l)	Ref.
Stonefly	FW				
Acroneuria pacifica		96 hr.	(F)	0.32	(16)
Stonefly	FW	24 hr.	(S)	4.0	(10)
Pteronarcys californica		48 hr.	(S)	0.96	(10)
		96 hr.	(S)	0.25	(10)
Stonefly	FW	24 hr.	(S)	2.8	(10)
Pteronarcella badia		48 hr.	(S)	1.7	(10)
		96 hr.	(S)	0.54	(10)
Stonefly	FW	24 hr.	(S)	3.2	(10)
Claassenia sabulosa		48 hr.	(S)	0.84	(10)
		96 hr.	(S)	0.76	(10)
Amphipod	FW				
Gammarus lacustris		24 hr.	(S)	6.4	(16)
		96 hr.	(S)	3.0	(16)
Korean shrimp	SW				
Palaemon macrodactylus		96 hr.	(F)	0.30	(13)
Sand shrimp	SW				

Crangon septemspinosa	96 hr.	(S)	1.7	(12)
Grass shrimp SW				
Palaemonetes vulgaris	96 hr.	(S)	1.8	(12)
Hermit crab SW				
Pagurus longicarpus	96 hr.	(S)	12.0	(12)
Oysters SW				
Crassostrea virginica	96 hr.	(F)	14.2 (EC50)	(41)
Pink shrimp SW				
Penaeus duorarum	96 hr.	(F)	0.037	(41)
Grass shrimp SW				
Palaemonetes pugio	96 hr.	(F)	0.63	(41)

(S) = static bioassay

(F) = flow-through bioassay

(SW) = salt water

(FW) = fresh water

B. Vertebrates

1) Fish

Of the commonly used insecticides, endrin is considered to be one of the most toxic (17, 18). For example, Katz and Chadwick in 1961 (19), cited 96-hour TLm values for a variety of freshwater salmonid fishes (see Table 3) as ranging from 0.27 ug/l for coho salmon, Oncorhynchus kisutch, to 0.92 ug/l for chinook salmon, O. tshawytscha. Katz in 1961 (17) reported 96-hour TLm values for chinook salmon, coho salmon, and rainbow trout as 1.2, 0.51, and 0.58 ug/l, respectively. Mount in 1962 (20) reported the 96-hour TLm for bluntnose minnows, Pimephales notatus, as 0.27 ug/l. The bluegill, Lepomis macrochirus, was reported as having a 96-hour TLm (LC50) value of 0.6 ug/l (19). Ferguson et al. (21) conducted 36-hour TLm studies using the black bullhead catfish, Ictalurus melas, and reported a value of 0.37 ug/l. These fish species are widely distributed throughout the fresh waters of the United States.

Marine or estuarine studies also have been conducted using a variety of species representative of coastal United States waters. Eisler (23) in 1970 reported static 96-hour LC50 values to vary from 0.3 ug/l for the striped killifish, Fundulus majalis to 3.1 ug/l for the Northern puffer, Sphaeroides maculatus. Katz in 1961 (17) reported static 96-hour TLm values of 0.44 and 0.50 ug/l for marine threespine sticklebacks, Gasterosteus aculeatus, in waters of 5 and 25 parts per thousand salinity, respectively.

Toxicity values for a variety of freshwater and marine ishes are shown in Table 3.

Table 3

Toxicity of Endrin to Various Fish Species

Organism	Duration	Type of Bioassay	LC50 (ug/l)	Ref.
Chincok salmon *Oncorhynchus tshawytscha*	96 hr.	(S)	1.2	(17)
Coho salmon *Oncorhynchus kisutch*	96 hr.	(S)	0.51	(17)
Coho salmon *Oncorhynchus kisutch*	96 hr.	(S)	0.27	(19)
Rainbow trout *Salmo gairdneri*	96 hr.	(S)	0.58	(17)
Rainbow trout *Salmo gairdneri*	96 hr.	(S)	0.90	(19)
Rainbow trout *Salmo gairdneri*	96 hr.	(U)	0.86	(9)
Bluntnose minnow *Pimephales notatus* (29.8 mm in length)	96 hr.	(U)	0.27	(20)
Bluntnose minnow *Pimephales notatus* (40.6 mm in length)	96 hr.	(U)	0.29	(20)
Bluntnose minnow *Pimephales notatus* (59.8 mm in length)	96 hr.	(U)	0.47	(20)
Fathead minnow *Pimephales promelas*	48 hr.	(F&S)	0.57 (F) 0.77 (S)	(25) (25)
Bluegill *Lepomis macrochirus*	96 hr.	(U)	0.7	(9)

Table 3 (cont.)

Toxicity of Endrin to Various Fish Species

Organism	Duration	Type of Bioassay	LC50 (ug/l)	Ref.
Mosquitofish *Gambusia affinis*	36 hr.	(U)	0.5	(21)
Channel Catfish *Ictalurus punctatus*	48 hr.	(U)	1.0	(14)
Northern Puffer *Sphaeroides maculatus*	96 hr.	(S)	3.1	(23)
Mummichog *Fundulus heteroclitus* (42 mm in size)	96 hr.	(S)	0.6	(22)
Striped Killifish *Fundulus majalis* (40 mm in size)	96 hr.	(S)	0.3	(23)
American eel *Anguilla rostrata* (57 mm in size)	96 hr.	(S)	0.6	(23)
Threespine stickleback *Gasterosteus aculeatus*	96 hr. (5ppt* salinity)	(S)	0.44	(17)
Threespine stickleback *Gasterosteus aculeatus*	(25 ppt* salinity)	(S)	0.50	(17)
Chinook salmon (fresh water) *Oncorhynchus tshawytscha*	96 hr.	(F)	0.14	(13)
Chinook salmon (salt water) *Oncorhynchus tshawytscha*	96 hr.	(F)	0.05	(13)
Sheepshead minnows *Cyprinodon variegatus*	96 hr. 33 days	(F) (F)	0.38 0.16	(41) (41)
Sailfin mollie *Poecilia latipinna*	96 hr.	(F)	0.63	(41)

Striped bass Morone saxatilis	96 hr.	(F)		0.094	(71)
Shiner perch Cymatogaster aggregata	96 hr.	(F)		0.12	(72)
		(S)	0.8	(72)	
Dwarf perch Micrometrus minimus	96 hr.			0.13	(72)
Dwarf perch Micrometrus minimus	96 hr.	(F)		0.13	(72)
		(S)		0.6	(72)
Spot Leiostomus xanthurus	24 hr.	(F)		0.45	(69)
Striped mullet Mugil cephalus	24 hr.	(F)		2.6	(69)
Menhaden Brevoortia patronus	24 hr.	(F)		0.80	(69)
Longnose killifish Fundulus similis	24 hr.	(F)		0.23	(69)
Sheepshead minnow Cyprinodon variegatus	24 hr.	(F)		0.32	(69)

S = Static bioassay
F = Flow-through bioassay
U = Undetermined whether static or flow-through bioassay

ppt = parts per thousand

Studies with the flagfish, Jordanella floridae, (45) and the sheepshead minnow, Cyprinodon variegatus, (75) indicate that long-term protection of the fishes and their reproductive abilities requires that the concentration of endrin be no greater than about three-tenths of their respective LC50 values (45, 75).

2) Birds

Tucker and Crabtree in 1970 (26) fed birds single endrin doses in capsules and computed the LD50 for mallards as 5.6 mg/kg; for young pheasants, 1.8 mg/kg; and for pigeons 2.0 to 5.0 mg/kg. In 1965, Heath and Stickel (27) reported the LC50 (mg/kg in diet) for bobwhite quail chicks as 15 mg/kg; for pheasant chicks, 11 mg/kg; and for mallard ducklings, 21 mg/kg of endrin. These birds were fed endrin daily in their food for 5 days at the stated concentrations.

3) Mammals

Toxicity data for mammals are few. Oral LD50 values of endrin to rats were reported to range from 1.8 to 43.0 mg/kg of body weight (28). In a similar study, using rabbits, the LD50 values ranged from 5.0 to 10.0 mg/kg body weight (28). Treon et al. in 1955 reported an oral LD50 value of 3 mg/kg body weight for monkeys (29). Toxicity values for a variety of mammalian species are shown in Table 5.

The mammalian toxicity of endrin in comparison with other chlorinated hydrocarbon pesticides can be seen in Table 4. Table 5 shows the toxicity of endrin to several species of mammals.

Table 4

Acute Oral and Dermal LD50 Values of Several Chlorinated Hydrocarbons to Rats (32)

Compound	Oral LD50 (mg/kg)		Dermal LD50 (mg/kg)	
	Males	Females	Males	Females
Toxaphene	90	80	1075	780
DDT	113	118	-	2510
Chlordane	335	430	840	690
Aldrin	39	60	98	98
Dieldrin	46	46	90	60
Endrin	18	8	-	15

The Food and Drug Administration (see Attachment C) has established an action level of 0.3 ppm (0.3 mg/kg) in processed fish and shellfish. This guideline has been

established to protect human consumers of fish and shellfish from endrin intoxication.

Table 5

Toxicity of Endrin to Various Species of Mammals

Organism	Test	Concentration	Ref.
White rat (M) (Sherman Strain)	Oral LD50	17.8 mg/kg	(32)
White rat (F) (Sherman Strain)	Oral LD50	7.5 mg/kg	(32)
Rat (Carworth Strain)	Oral LD50	7.3 - 43 mg/kg	(29)
Guinea Pig (F)	Oral LD50	16 mg/kg	(29)
Guinea Pig (M)	Oral LD50	36 mg/kg	(29)
Rabbit	Oral LD50	5 - 10 mg/kg	(29)
Dog (Beagle)	Oral LD50 (death within 6 wks.)	10 mg/kg	(29)
Monkey	Oral LD50	3 mg/kg	(29)

4) Human

Endrin has been reported to cause convulsions or death in humans following consumption of contaminated foods, inhalation or sorption. A compilation of data developed by the Commission of the European Communities details the cases both in the United States and abroad (73). It was reported that convulsions begin at blood levels of 0.053 uq/ml. However, there is a rapid elimination of endrin from the blood. Within 30 minutes after convulsion was induced by 0.053 uq/ml blood levels, endrin could no longer be detected in the blood.

IV. Environmental Fate and Effects

Endrin may be transported to water bodies by direct discharges from manufacturing plant effluent pipes, by drifting air sprays applied to fields, and by runoff from treated soils. Once in the aquatic environment it can persist in the water column, or may enter sediments. Plants or animals may bioaccumulate endrin. Transfer of endrin from water to organism or sediment, or from organism to organism has been shown to occur (4, 40, 44). Endrin-resistant strains of food organisms have been shown capable of transferring lethal doses of the pesticide to fish, reptiles or birds (44). Bioaccumulation levels in fish found in nature have been reported as high as 12,000 ug/kg of dry body weight, while 214,000 ug/kg (428 times the water concentration) have been achieved in resistant fish living in the laboratory (40).

Endrin can persist in soils for many years. For instance, 41 percent of the endrin applied to a Beltsville, Maryland, plot was present after fourteen years (33). In that case, the soil was not cropped as often as normal agricultural soil and the insecticide was applied at very

high levels (25 and 100 mg/Kg) and thoroughly mixed into the soil. These conditions leave little of the pesticide on the soil surface where volatilization and photodecomposition can occur. It has been suggested that high rates of application of endrin might destroy soil organisms which could otherwise decompose endrin (33).

Winnett and Reed (34) in 1968 demonstrated that a single endrin application of 3 to 6 pounds per acre produced residues during the first two years in potatoes grown in the soil. There is no indication that the soil itself was tested. Solar, et al., in 1971 (35) reported that about 80 percent of the endrin residue in Irish and sweet potatoes remained after 12 weeks storage.

On the other hand, Asai and associates (8) reported in 1969 that between 10 and 80 percent of endrin decomposed on air-dried soil at 25° C in twelve hours. The loss primarily was due to transformation of endrin to the ketone and aldehyde forms. This decomposition was not apparent on wet soils. Ultraviolet light also degrades endrin to a ketone, which has been found in fields originally treated with endrin (7). Patil et al. (36) in 1970 tested twenty

cultures of soil microorganisms and found that all degraded endrin. Studies of soils have consistently reported low or absent endrin residues since the mid 1960's (37, 38).

Cole, et al. in 1968 (55) found that endrin applied to soil at 100,000 ug/kg decreased the weight (above ground) of corn Zea mays. Growth of bean, Phaseolus vulgaris, plants was retarded by endrin at 10,000 ug/kg.

Following the 7-day exposure of 4 algal species to 1 mg/l of endrin, the algae concentrated endrin about 170-fold under the test conditions (49). Batterton, et al. (54) reported in 1971 that the growth rates of two strains of blue-green algae were decreased by endrin at concentrations as low as 0.2 ug/l. One strain was also inhibited by the metabolite ketoendrin at 475 ug/l, while growth of the other was unaffected.

Rowe, et al. in 1971 (42) studied oysters in a Louisiana estuary and concluded that uptake of pesticides depends on temperature (low temperature yields low uptake) and rainfall (heavy rainfall increases uptake due to sediment input and roiling).

Eastern oysters, Crassostrea virginica, were observed to concentrate endrin from water (42). Wilson (48) reported in 1965 that oysters exposed to endrin at 1 ug/l concentrated it about 1,000 times during a 10-day exposure period. In 1966 Lowe (69) reported that an eight month exposure of spot, Leiostomus xanthurus, to 0.05 ug/l of endrin resulted in whole body residues of 67 ug/g. A second test of five months duration produced residues of 78 ug/g, a concentration factor of 1560. When exposed fish were placed in endrin-free water for 13 days no endrin was detectable in their tissues. Endrin residues in channel catfish, Ictalurus punctatus, tissue were shown to be reduced by about 95 per cent after 13 days, with the concentration falling from 0.41 ug/g to 0.02 ug/g (74). Marine spot, Leiostomus xanthurus, tissue residues of 0.78 ng/g were reduced below detection levels within 13 days (69).

Endrin residue accumulation of 10,000-fold was found in flagfish exposed for 60 days to a concentration of 0.3 ug/l (45). A 26,000-fold increase was reported for the medaka, Oryzias latipes (46). Fathead minnows exposed to water containing 0.015 ug/l of endrin concentrated the endrin by 10,000 times (47).

Ferguson, et al. in 1960 (40) provided a dramatic illustration of the ability of the mosquitofish, Gambusia affinis, to both absorb and excrete endrin. A single endrin-resistant female fish was exposed to a concentration of 1,000 ug/l and then released into 10 liters of tap water with five susceptible fish. All except the resistant fish died within forty hours.

Rosato and Ferguson in 1968 (44) force-fed endrin-resistant mosquitofish loaded with endrin to eleven species of "predators" including fish, frogs, turtles, snakes and .rds with "predator" to "prey" weight ratios ranging from 35:1 to 757:1. Ninety-five percent of the "predators" died. The concentration of endrin in the mosquitofish was 890 ug/kg. In an earlier study, Ferguson, et al., 1966 (40) found that field-collected mosquitofish contained as much as 6,800 to 11,900 ug/kg (dry weight) of endrin in the wild and 214,000 ug/kg after a two-week exposure to 500 ug/l in the laboratory.

Ferguson et al. (70) noted the absence of top predators such as bass and crappie as well as very large numbers of mosquitofish in an area contaminated by insecticides. These

data suggest that bioaccumulation of insecticides in the food chain may result in population shifts.

Bridges in 1961 (39) studied a pond which was inadvertently sprayed with sufficient endrin to kill fish and found that endrin became undetectable in the water within one month and persisted in the mud for only two months. However, fish from a commercial hatchery kept in cages in the pond after no more of the pesticide was detected in the water column accumulated detectable levels of endrin in four days. Whether the endrin came from the water, mud or food organisms is unknown. Other incidents of endrin-related fish kills are documented in Appendix A.

Epps, et al. in 1967 (43), in a study of Louisiana watersheds, found that endrin residues in water seemed to parallel land application of endrin. They reported residues as high as 870 ug/kg in gizzard shad, Dorsoma cepedianum, in the Chevreuil basin.

As seen in Attachment B, the brown pelican population in the Lower Mississippi Valley began to decline when endrin was re-introduced in 1974 for cotton insect control to the

area. Chemical analysis of the brains of dead birds revealed levels of endrin which could account for their deaths. The brown pelican is a fish predator and would receive endrin by way of the food chain as demonstrated by Rosato and Ferguson in 1968 (44) when consumption of endrin-resistant mosquitofish loaded with endrin resulted in the death of "predators."

Terriere, et al. in 1959 (50) studied the effect of dietary endrin on the endrin concentrations in poultry and eggs. Endrin content was measurable in body fat even at the lowest level of intake (100 ug/kg). At intake levels of 250 ug/kg and 750 ug/kg endrin became detectable in eggs after eight weeks (200-360 ug/kg). The body fat burdens of the poultry were found to be as high as 1,600 ug/kg when the birds were fed 750 ug/kg endrin, and reached 17,000 ug/kg at the 2,250 ug/kg dietary level.

Terriere, et al. in 1958 (51) and Kiigemagi, et al., also in 1958 (52) found that 100 ug/kg of endrin in the diet of cattle caused little or no accumulation in body tissues. At the 2,000 ug/kg dietary level body fat residues rose to 900 ug/kg in steers and 1,000 ug/kg in dairy cows. In

steers these body fat residues declined to 300 ug/kg after six weeks on an endrin-free diet. Much lower levels were found in tissues other than fat. For example, at the 750 ug/kg dietary level, steaks from the short loin area, roasts from the loin and arm area, and kidney contained no detectable quantities of endrin, while liver contained 200 ug/kg. At the 2,000 ug/kg level steaks contained 30 ug/kg, roasts and liver 200 ug/kg and kidney no detectable endrin.

In 1958 Terriere, et al. (51) found no endrin residues in steaks, roasts, kidney or liver of lambs and hogs fed as much as 750 ug/kg for twelve weeks. Richardson, et al. in 1967 (53) fed diets containing 100 ug/kg endrin to dogs. In this study, endrin concentration quickly reached 3-6 ug/ml of blood and then varied erratically between approximately 2 and 8 ug/ml.

Reins, et al. in 1964 (57) studied the effects of endrin on renal function in dogs. They found that acute intoxication lowered renal blood flow, glomerular filtration rate, and urine flow, but that chronic exposure to subacute levels had only slight renal and hemodynamic effects.

Numerous studies have documented biochemical effects of endrin, although no clear picture of the mechanism(s) underlying its toxicity has yet emerged. It has been shown to inhibit the enzymes succinic dehydrogenase (58, 59); cytochrome oxidase (59), Na^+, K^+ --adenosine triphosphatase, Mg^{++} --ATPase (60), and NADH oxidase, an electron transfer cofactor, (61) to varying degrees. Endrin has been reported to cause shifts in the organ distributions of iron, magnesium, zinc and copper at acute dosages (62), increased magnesium and zinc concentrations and decreased zinc excretion in animals (63), as well as minor alterations in the levels of phosphorus, potassium, magnesium, manganese, iron, copper, boron, and zinc in plants (55). High lipid content seems to correlate with endrin resistance in mosquitofish (64).

Limited information on endrin elimination mechanisms is available. However, Cole, et al. (65) have followed the excretion of ^{14}C from labeled endrin given intravenously to rats. They found that more than 90 percent of the ^{14}C was eliminated in the feces, 75 percent of it the first day. Labeled dieldrin required three days for 50 percent excretion of ^{14}C. This was at least partly due to the fact

that endrin reached the bile much faster (50 percent in one hour, compared to ? percent in six hours for dieldrin).

Baldwin et al. (66) found in 1970 that in rat tissues endrin was converted to the ketone by replacement of the methylene group with a carbonyl group, and that in the feces, two alcohols were formed, one of which could be oxidized to the tissue ketone. In lower animals (tobacco budworm larvae), Polles and Vinson (67) found that most 14C endrin was excreted as unchanged endrin.

V. Criteria Formulation

Chronic level: .004 ug/l

Endrin is an extremely toxic pesticide capable of killing both vertebrate and invertebrate aquatic organisms at concentrations in the parts per trillion range. The 96-hour LC50 for the chinook salmon, Oncorhnychus tshawytscha, was reported as 0.048 ug/l in salt water and 0.14 ug/l in fresh water (13); the pink shrimp, Penaeus duorarum, had a reported 96-hour LC50 of 0.037 ug/l (41).

Fish have been shown capable of concentrating endrin in their tissues and upon subsequent ingestion by predators, of causing endrin intoxication and death in other fish, turtles, snakes and birds (44). Bioaccumulation of endrin in fish has been shown to be as high as 26,000 times the water level (46).

Fathead minnows, Pimephales promelas, exposed to 0.015 ug/l of endrin, had total body concentrations 10,000 times greater than the water (47). Residue accumulation up to 10,000-fold was observed in flagfish, Jordanella oridae, exposed for 60 days to concentrations between 0.05 and 0.3 ug/l (45).

In 1967, Johnson (46) calculated the concentration in adult medaka tissue to be 17,000 to 26,000 times the water concentration. This degree of accumulation is based only on observations of uptake directly from the water and does not allow for accumulation via the food chain or significantly higher accumulation rates possible in other, untested fish species. While the medaka is not a native U.S. species, there is no reason to suppose that such bioaccumulation levels could not be reached by native species.

Endrin has been found to be eliminated quickly after termination of exposure. Channel catfish tissue residues were reduced from 0.41 to 0.02 ug/l (about 95-percent reduction) within 13 days after the addition of endrin to the water was stopped (74). Marine spot tissue residues of 78.0 ppb were reduced below detection levels within 13 days (69).

Acute toxicity studies have generated LC50 values of less than 0.2 ug/l for chinook salmon, Oncorynchus tshawytscha (13), the striped bass, Morone saxatilis (71), the shiner perch, cymatogaster aggregata (72), the dwarf perch, Micrometrus minimus (72), and the pink shrimp, Penaeus duorarum (41). The LC50 value for the chinook salmon in salt water was reported as .048 ug/l, while that for the pink shrimp was 0.037 ug/l. Hermanutz (45) showed that the maximum acceptable toxicant concentration of endrin for the flagfish, Jordanella floridae, lies between 0.26 and 0.35 of the 96-hour LC50.

These results suggest that the application factor of 0.01 of the 96-hour LC50 recommended by the NAS-NAE (76) is overprotective and that a factor of 0.1 will assure adequate protection

of sensitive aquatic species. Based on the 0.037 ug/l 96-hour LC50 for the pink shrimp, Penaeus duorarum, application of this factor yields a criterion of 0.004 ug/l.

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GLOSSARY

Acutely toxic: Causing death or severe damage to an organism by poisoning during a brief exposure period, normally ninety-six hours or less.

Anadromous fishes: Fishes that spend a part of their lives in seas or lakes, but ascend rivers and streams at certain intervals to spawn. Examples are sturgeon, shad, salmon, trout, and striped bass.

Application factor: The ratio of the safe concentration to the lethal concentration as determined for potential aquatic pollutants administered to species of interest.

Bioaccumulation (Bioconcentration): The phenomenon wherein elements or compounds are stored in living organisms because elimination fails to match intake.

Carcinogenic: Producing Cancer.

Catadromous fishes: Fishes that feed and grow in fresh water, but return to the sea to spawn. The best example is the American eel.

Chronically toxic: Causing death or damage to an organism by poisoning during prolonged exposure, which, depending on the organism tested and the test conditions and purposes, may range from several days, to weeks, months, or years, or through a reproductive cycle.

EC50: The concentration at which a specified effect is observed under the test conditions in a specified time in fifty percent of the organisms tested. Examples of specified effects are hemorrhaging, decreased feeding, dilation of pupils, and altered swimming patterns.

Epilimnion: That region of a body of water that extends from the surface to the top of the thermocline and does not have a permanent temperature stratification.

Flow-through bioassay: An assay system in which aquatic species are exposed to toxicants in a constantly flowing system, and where the toxicant is replenished continuously or discontinuously.

Hardness (Water): The concentration of the polyvalent metallic ions dissolved in water. Unually it is reported as the equivalent concentration of calcium carbonate ($CaCO_3$).

Hyperplasia: Abnormal multiplication or increase in the number of normal cells in normal arrangement in a tissue.

Hypolimnion: The region of a body of water that extends from the bottom of the thermocline to the bottom of the water body and is essentially independent of most surface phenomena.

LC25: The concentration of a toxicant that is lethal (fatal) to twenty-five percent of the organisms tested under the test conditions in a specified time.

LC50: The concentration of a toxicant which is lethal (fatal) to fifty percent of the organisms tested under the test conditions in a specified time. It is virtually identical with TLm and TL50.

LD50: The dose of a toxicant that is lethal (fatal) to fifty percent of the organisms tested under the test conditions in a specified time. A dose is the quantity actually administered to the organism and is not identical with a concentration, which is the amount of toxicant in a unit of test medium rather than the amount ingested by or administered to the organism.

Liter (l): The volume occupied by one kilogram of water at a pressure of 760 mm of mercury and a temperature of 4 °C. A liter is 1.057 quart.

Methylmercury: Mercury which has been methylated, usually through some biological agent, such as bacteria.

Microgram per liter (ug/l): The concentration at which one millionth of a gram (one microgram) is contained in a volume of one liter. Where the density of solvent is equal to one, one ug/l is equivalent to one part per billion (ppb) or one microgram per kilogram (ug/kg).

Microgram per kilogram (ug/kg): The concentration at which one millionth of a gram (one microgram) is contained in a mass of one kilogram. A kilogram is 2.2046 pounds.

Milligram per kilogram (mg/kg): The concentration at which one thousandth of a gram (one milligram) is contained in a mass of one kilogram. A gram contains 1000 milligrams.

Milligram per liter (mg/l): The concentration at which one milligram is contained in a volume of one liter. Where the density of the solvent is equal to one, one mg/l is equivalent to one part per million (ppm) or one milligram per kilogram (mg/kg).

Milliliter (ml): A volume equal to one thousandth of a liter.

Nanogram per liter (ng/l): The concentration at which one billionth of a gram (one nanogram) is contained in a volume of one liter. Where the density of the solvent is equal to one, one ng/l is equivalent to one part per trillion or one nanogram per kilogram (ng/kg).

Neoplastic: Describing any new and abnormal growth, such as a tumor.

Part per million (ppm): A concentration in which one unit is contained in a total of a million units. Any units may be used (e.g., weight, volume) but in any given application identical units must be used (e.g., grams per million grams or liters per million liters). Where the density of the solvent is one, one part per million is equivalent to one milligram per liter.

Parts per thousand (o/oo): A concentration at which one unit is contained in a total of a thousand units. The rules for using this term are the same as those for parts per million. Normally, this term is used to specify the salinity of estuarine or sea waters.

Piscicide: A substance used for killing fish.

Static bioassay: A bioassay in which the toxicant is not renewed during the test.

Thermocline: That layer in a body of water where the temperature difference is greatest per unit of depth. It is the layer in which the drop in temperature is 1 °C. or greater per meter of depth.

TLm - Median Tolerance Limit: The concentration of a test material at which fifty percent of the test animals are able to survive under test conditions for a specified period of exposure. It is virtually synonymous with LC50 and TL50.

TL50: Synonymous with TLm and virtually synonymous with LC50.

Tumorigenic: Causing or producing tumors.

Appendix A: Fish Kills

Attached is a table which documents endrin-associated fish kills in field situations. Many of these kills involve the death of hundreds of thousands of fish, some of which are of great economic importance and all of which are important links in the food chain. These fish kill data are not exhaustive but serve to illustrate the magnitude of endrin-associated fish mortality.

Endrin-Associated Fish Kills

Date	Estimated Number of Fish Killed	Types of Fish Killed	Location (Nearest Town or County)
9-4-74	64,526	Game - 2% Non-Game - 98%	Webbers Falls, OK
8-18-74	3,538	Game - 96% Non-Game - 4%	Tuscaloosa, Ala.
9-10-74	2,988	Game - 9% Non-Game - 91%	Lawrence, Ala.
8-17,18-70	858	Game - 19% Non-Game - 81%	Sheffield, Ala.
8-8-14-74	54,233	Game - 3% Non-Game - 97%	Franklin, Tenn.
1-25-74	Unknown	Game -100%	Cana, Va.
9-3-74	31	Game - 87% Non-Game - 13%	Tuscaloosa, Ala.
9-12-74	13,592	Game - 60% Non-Game - 40%	Sawyersville, Ala.
8-20-74	47	Game - 72% Non-Game - 28%	Greensboro-Hale, Ala.

Date	Estimated Number of Fish Killed	Types of Fish Killed	Location (Nearest Town or County)
9-9-74	28,248	Game - 3% Non-Game - 97%	Decatur, Ala.
9-15-74	4,216	Game - 28% Non-Game - 72%	Cullman, Ala.
8-17-74	14,350	Game - 42% Non-Game - 58%	Hokes Bluff, Ala.
8-4-74	29,747	Game - 9% Non-Game - 91%	Selma, Ala.

Appendix B

Brown Pelican Mortality Data

LOUISIANA COOPERATIVE WILDLIFE RESEARCH UNIT
208 FORESTRY BUILDING
LOUISIANA STATE UNIVERSITY
BATON ROUGE, LOUISIANA 70803

COOPERATING AGENCIES
LOUISIANA WILD LIFE & FISHERIES COMMISSION
LOUISIANA STATE UNIVERSITY
WILDLIFE MANAGEMENT INSTITUTE
BUREAU OF SPORT FISHERIES & WILDLIFE

January 5, 1976

Mr. Leonard J. Guarraia, Chief
Criteria Branch
Criteria and Standards Div.
Environmental Protection Agency
WH585-401 Mst. SW
Washington, D.C. 20460

Dear Mr. Guarraia:

In response to your request I am forwarding herewith copies of residue analysis reports on brown pelicans, together with a letter from Dr. Lucille Stickel in which she discusses the work that has been done at Patuxent Wildlife Research Center relative to the determination of lethal levels of Endrin in the brains of birds.

As you can readily see the levels of Endrin found in the brains of those pelicans analyzed were generally within the range considered to be lethal by Dr. Stickel. These data indicate that it is safe to assume that Endrin was the cause of mortality in these birds.

As an additional matter of interest, you are probably aware of the total disappearance of the brown pelican from the Louisiana Gulf Coast in the early 1960's. The cause of this disappearance has not been documented, although there has been widespread speculation. Pelicans were reintroduced to Louisiana from Florida beginning in the late 1960's. The introduced population was thriving in the Barataria Bay Area of Louisiana until the spring of 1975 when it suffered a decline - reported to be greater than 50%. (By the Louisiana Wild Life and Fisheries Commission).

The decline followed the widespread use of Endrin in certain areas of Arkansas, Louisiana and Mississippi in 1974 for cotton insect control. This, to my knowledge was the first widespread use of Endrin in the Mississippi River drainage system since the early 1960's.

If I can be of further assistance please notify me.

Very truly yours,

John D. Newsom

JDN:dh
Attachments

Pelicans

ANALYTICAL REPORT

PR-1024

Submitter: Mr. John Newsom, Leader, Cooperative Wildlife Research Unit, Louisiana State University, Baton Rouge, Louisiana

Specimen Data: Two brown pelicans found dead at Grande Terre, Louisiana on 22 May 1975. One (A-8107) bore USFWS band number 519-62285.

Specimen No.	Autopsy No.	Identification	Wet Weight (grams)	Lipid Weight (grams)
75-1159	A-8107	Carcass	10.00	0.25
75-1160	A-8107	Brain	17.17	1.02
75-1161	A-8108	Carcass	10.00	0.33
75-1162	A-8108	Brain	12.10	0.72

Analysis: organochlorine compounds, residues in samples 75-1160 and 75-1161 were confirmed by GC-MS.

Results: ppm wet weight; lower limit of detection - 0.10 ppm

Compound	75-1159 Carcass	75-1160 Brain	75-1161 Carcass	75-1162 Brain
p,p'-DDE	3.8	0.36	5.0	1.0
p,p'-DDD	0.40	0.09	1.0	0.27
p,p'-DDT	0.20	0.09	0.25	-
Dieldrin	3.5	1.9	4.8	2.1
Heptachlor epoxide	0.63	0.32	1.0	0.31
Mirex	-*	-	-	-
Oxychlordane	-	-	-	-
**cis-Chlordane	0.80	0.28	1.4	0.31
cis-Nonachlor	0.13	-	0.17	-
HCB	0.08	-	0.09	0.02
Toxaphene	1.4	0.57	1.9	0.41
Endrin	1.5	0.70	2.1	0.18
PCB as 1260	7.3	3.5	11.	1.5

* - = not detected
**and/or trans-nonachlor

W. L. Reichel
Chief Chemist

Feed and Fertilizer Laboratory
Samples submitted by Dr. John Newsom
June 5, 1975

Lab. No.	Sample	ppm Alpha BHC	ppm HCB	ppm p,p'DDE	ppm Toxaphene	ppm PCB*	ppm Dieldrin	ppm Endrin
	Brown Pelican Brains							
1039X	#1	0.16	0.09	0.89	3.8	3.4	0.64	0.33
1040X	#2	0.11	0.08	0.76	3.4	3.2	0.59	0.30
1041X	#3	0.10	0.07	0.73	2.7	3.2	0.42	0.23
1042X	#4	0.13	0.11	1.52	6.5	6.0	0.78	0.37
1043X	#5	0.24	0.15	1.72	6.6	7.4	1.08	0.48

*as Aroclor 1254

Feed and Fertilizer Laboratory
Samples submitted by Dr. John D. Newsom
June 2, 1975

Lab. No.	Sample (Grand Terre)	ppm Alpha BHC	ppm HCB	ppm H.epoxide	ppm Toxaphene	ppm Dieldrin	ppm Endrin	ppm p,p'DDE
946X	Brown Pelican brain	0.21	0.11	0.33	7.4	0.95	0.70	1.19

ppm PCB as Aroclor 1254
5.1

Feed and Fertilizer Laboratory
Samples submitted by Dr. John Newsom
June 5, 1975

Lab. No.	Sample	ppm Alpha BHC	ppm HCB	ppm p,p'DDE	ppm Toxaphene	ppm PCB*	ppm Dieldrin	ppm Endrin
	Brown Pelican Brains							
1039X	#1	0.16	0.09	0.89	3.8	3.4	0.64	0.33
1040X	#2	0.11	0.08	0.76	3.4	3.2	0.59	0.30
1041X	#3	0.10	0.07	0.73	2.7	3.2	0.42	0.23
1042X	#4	0.13	0.11	1.52	6.5	6.0	0.78	0.37
1043X	#5	0.24	0.15	1.72	6.6	7.4	1.08	0.48

*as Aroclor 1254

B13a1

United States Department of the Interior

FISH AND WILDLIFE SERVICE
PATUXENT WILDLIFE RESEARCH CENTER
LAUREL, MARYLAND 20811

WRes
May 2, 1975

Reproduced from best available copy.

Dr. L. D. Newsom
Department of Entomology
Louisiana State University
402 Life Sciences Building
Baton Rouge, Louisiana 70803

Dear Dr. Newsom:

Your letter of March 24, 1975 poses a number of difficult questions. I delayed answering pending results of analyses of the white pelican brains that were nearly completed. The analyses proved more complex than anticipated and only now have been completely checked and reported. A copy of the analytical report is enclosed.

I will discuss your questions in order. First, I did not recall the examination and diagnosis of disease in brown pelicans in 1956. I have discussed this matter with Dr. Locke, a veterinarian-histopathologist on our staff who has worked with us in pollution research for many years. He says that brown pelicans would be susceptible to Newcastle Disease, but that the statement, "a virus similar to Newcastle Disease", has no meaning in a technical sense, being more a summary for general consumption. He asked if by any chance the complete autopsy report might be available for whatever clues it might offer. It would be better still if samples remained, but I assume this is not so.

You also mention analyses of brown pelicans taken during the decline. Are reports of these analyses available? We would be very much interested in seeing them.

We are, of course, pleased with the success of the pelicans transported to Louisiana; one of our biologists has worked with Mr. Joanen and we have analyzed some eggs. The residues were low, which was encouraging. Success now and failure earlier obviously means that something changed. I would not care to venture a guess, but only to hope that it stays changed so that the pelican can become a bona fide Louisiana citizen again.

AMERICAN REVOLUTION BICENTENNIAL 1776-19[illegible]

TELEPHONE—AREA CODE 301 776-4880 (MARYLAND EXCHANGE)
TELEGRAMS—FISH AND WILDLIFE SERVICE, WASHINGTON, D.C. 20240

Reproduced from best available copy.

It does not seem likely that pesticide levels on the Gulf have remained unchanged for 20 years. Perhaps we can never take a firm position on what happened to the pelicans unless more data are found.

I am convinced, however, that introduction of DDT into the environment has had seriously deleterious effects on reproduction of many species of birds, and in some instances on populations. The brown pelican is particularly sensitive to the reproductive effects of DDE; it has been seriously affected in both California and South Carolina. I surely hope that it will not become necessary to resume the large-scale use of DDT in the South, which remains one of the most significant wildlife areas in our country.

Both reproductive success and mortality must be considered before one can feel confident that a given environmental contaminant poses no hazard. Reproductive effects are deceptive because they are slow, subtle, and do not affect all species of an area. We can miss them entirely until a population is far gone. There are several examples of this happening.

The diagnosis of death due to chemical poisoning should be based upon a careful autopsy plus residue analysis. Even then there are individual borderline cases that cause one to suspect an interaction between chemicals or between chemicals and other factors, including disease. We have done several studies to attempt to understand this and have pretty strong indications of chemical additivity. We are now preparing to conduct a more definitive experiment, with particular attention to dieldrin, which is prevalent in bald eagles.

We were surprised to learn of the endrin in the pelican brains. Levels as low as 0.3 ppm in the brain have killed birds in experimental studies, with amounts ranging up to 1.8 ppm. The limits have not been defined in detail and the significance of 0.2 ppm is uncertain. Levels of 0.3 to 0.8 ppm are common among endrin-killed birds.

As you will see in the analytical report, the endrin in the brains of these two pelicans was at hazardous levels. Several other chemicals were present in substantial amounts. The possible contribution of such an array in lowering lethal levels of one of them is the subject of current studies.

I recall very clearly a visit we had with you in Baton Rouge in 1959 or 1960 when we were working on woodcocks in relation to the use of heptachlor. It was most heartening to encounter your open-minded view of the problem of the effects of chemicals on wildlife and your concern for endrin use on cane. I hope it will be possible for you to encourage the development and

adoption of management methods and chemical control methods for cotton pests that will not entail the use of DDT or other highly persistent chemicals.

With best regards.

Sincerely yours,

Lucille F. Stickel

Lucille F. Stickel
Director

Enclosure

Appendix C

FDA Guideline for Endrin in Fish

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
FOOD AND DRUG ADMINISTRATION
ROCKVILLE, MARYLAND 20852

May 1, 1974

RECEIVED
MAY 1974
REGISTRATION DIVISION
PESTICIDES, EPA

Dr. John B. Ellch, Jr.
Director, Registration Division
Office of Pesticide Programs
U.S. Environmental Protection Agency
Waterside Mall, E. Tower - Room 347
Washington, D.C. 20460

Dear John:

As requested at our meeting on April 19, 1974, I am enclosing copies of the pesticide administrative guidelines (action levels) FDA applies to certain food and feed products. The purpose of your request is to afford EPA an opportunity to review and comment, where deemed appropriate, on these action levels.

You will note that page 1 of the guidelines contains instructions for FDA field offices to follow regarding the circumstances in which the action levels are to be applied. For the most part, the action levels listed are for foods for which there are no established tolerances under sections 408 and 409 of the Food, Drug, and Cosmetic Act. However, guidelines are listed for certain pesticides and crops where legal tolerances currently exist. These listings are not to be misinterpreted as "tolerances-on-top-of-tolerances." Instead, they provide criteria our field offices are to follow in the event foods are found in excess of these legal tolerances, i.e. above the guideline, the field office may directly refer a seizure recommendation to our General Counsel; below the guideline, but above the legal tolerance the seizure recommendation must first be referred to our Bureau of Foods.

The action levels for DDT, lindane, and BHC in cocoa beans, dieldrin in oil-seed by-products, and chlordane in animal feed and feed ingredients that EPA recently provided FDA have not been incorporated into FDA's Administrative Guideline Manual as yet. However, we intend to include them in the near future. The action levels used by USDA for pesticide residues in the tissue of livestock and poultry are not included in the FDA listing.

If you have any questions on the enclosures, please contact me.

Sincerely yours,

John R. Wessel
Scientific Coordinator
Office of the Associate Commissioner
for Compliance

Commodity Code: 00

PRODUCT: Processed Foods or Feeds

PROBLEM: Adulteration - Food Additives

REMARKS

Direct seizure referral to General Counsel or referral to Division of Regulatory Guidance with a recommendation for legal action is authorized when both the original and check analysis show pesticide residues at or above the criteria specified in the Guideline. Both the original and check analysis must be cofirmed by an appropriate identification method such as thin layer chromatography.

Do not refer seizure directly when combinations of pesticides are encountered other than those combinations specified in this Guideline. If other combinations are encountered, refer recommendations for legal action to Division of Regulatory Guidance.

The criteria specified in this Guideline have been set to allow for variance in analytical results. This Guideline will be reviewed periodically and revised as necessary.

The criteria specified in this Guideline apply to objective samples. This does not limit or prohibit recommending legal action to Division of Regulatory Guidance on lower residue levels if there is evidence of misues of pesticides, or if some other factor appears to warrant action. Referral to DRG is authorized where both the original and check analysis exceed the legal tolerance but do not meet or exceed the administrative guideline, provided sampling and analytical techniques are adequate to prove conclusively that the legal tolerance has been exceeded. In such case all analytical data including work sheets should be submitted along with the recommendation for action.

The criteria in this Guideline are given in parts per million on an "as is" basis unless otherwise specifically noted. For the purposes of this Guideline samples should be examined as shown below and recommendations for legal action must clearl indicate the exact portion of the food used for analysis.

Tomato Pomace, Milk, Citrus Pulp-Product as received or when introduced into interstate commerce.

FISH (SMOKED, FROZEN OR CANNED):

(1) Canned in Brine; drain and discard brine, examine remainder,

(2) Canned in Oil or Sauce; examine a homogeneous mixture of can contents.

(3) Frozen; thaw, drain discard drainings remove and discard heads, scales and guts, examine remainder, including tails if present.

(4) Smoked; remove and discard heads, scales and guts, examine remainder including tails if present.

FROG LEGS

Discard bones; examine edible meat only.

SHELLFISH (FROZEN OR CANNED)

(1) Clams and Oysters (Frozen or canned); examine a homogeneous mixture of meats and liquor.

(2) Shrimp and Similar Shellfish;
(a) Breaded; examine as received
(b) Canned in Brine; drain and discard brine; examine edible meat.
(c) Raw Frozen; thaw, discard drainings, remove and discard heads, tail and shell examine edible meat only.

NOTE: The original screening analysis can be made on the sample as received ("as is") if it is found that this saves time. However, when residues are encountered over the criteria levels the sample must be re-assayed on the portion specified above and a check analysis must also be done on the portion specified if the re-assay confirms residues over the criteria level.

The criteria levels herein are not applicable directly to any combinations of pesticides except those specifically noted (e.g., dieldrin & aldrin, etc.). Recommendation for legal action in these instances will be left to District judgement.

RECEIVED 8 MAY 1974

SPECIMEN CHARGE

Article adulterated when introduced into and while in interstate commerce within meaning of 21 U.S.C. (C), in that it contains malathion a food additive which is unsafe within meaning of 21 U.S.C. 348 since it and its use and intended use are not in conformity with the regulations or exemp: in effect pursuant of 21 U.S.C. 348.

INDEX

Pesticide	Attachment
BHC	A
DDT & TDE	B
DDT, DDE & TDE	C
DIELDRIN AND ALDRIN	D
ENDRIN	E
HEPTACHLOR & HEPTACHLOR EPOXIDE	F
LINDANE	G
MALATHION	H
METHOXYCHLOR	I

RECEIVED 8 MAY 1973

BHC

The figures below are to be used for total BHC. However, in adding amounts of individual isomers do not count alpha, gamma or delta BHC at a level below 0.05 ppm in frog legs and below 0.1 ppm in the other products. Do not count beta BHC at a level below 0.1 ppm in frog legs and below 0.2 ppm in the other products.

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

0.3 PPM (ON FAT BASIS)

BUTTER

OTHER MANUFACTURED DAIRY PRODUCTS, including pasteurized or otherwise processed milk, excluding low fat dairy products.

0.5 PPM

FROG LEGS (MEAT ONLY)

DDT AND TDE
(CFR 121.226 and 121.227)

The figure below is for the above pesticides individually or in combination.

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

110 PPM

TOMATO POMACE

DDT, DDE AND TDE
(CFR 121.1093(a))

The figure below is for the above pesticides individually or in combination. However, in adding amounts of DDT, DDE and TDE do not count any of the three found below 0.3 ppm. on a fat basis; for fish do not count any of the three below 0.2 ppm.

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

1.5 PPM (ON FAT BASIS)

BUTTER
OTHER MANUFACTURED DAIRY PRODUCTS, including pasteurized or otherwise processed milk, excluding low fat dairy products.

5 PPM

FISH, Smoked, frozen or canned

DIELDRIN AND ALDRIN

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

The figures below are for the above pesticides individually or in combination. However, in adding amounts of dieldrin or aldrin do not count dieldrin or aldrin found at a level below 0.3 ppm (on fat basis) for butter and dairy products or below 0.03 ppm for other products.

0.3 PPM (ON FAT BASIS)

BUTTER

OTHER MANUFACTURED DAIRY PRODUCTS, including pasteurized or otherwise processed milk, excluding low fat dairy products.

0.3 PPM

FISH Smoked, frozen or canned
SHELLFISH Smoked, frozen, or canned

0.1 PPM

SUGARBEET PULP

ENDRIN

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

0.3 PPM (ON FAT BASIS)

BUTTER

OTHER MANUFACTURED DAIRY PRODUCTS, including pasteurized or otherwise processed milk, excluding low fat dairy products.

0.3 PPM

FISH, Smoked, frozen, canned
SHELLFISH, Smoked, frozen canned

HEPTACHLOR AND HEPTACHLOR EPOXIDE

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

The figures below are for the above pesticides individually or in combination. However, in adding amounts of heptachlor and heptachlor epoxide do not count heptachlor or heptachlor epoxide found at a level below 0.3 ppm (on fat basis) for butter or manufattured dairy products or 0.03 for fish and shellfish.

0.3 PPM (ON FAT BASIS

BUTTER

OTHER MANUFACTURED DAIRY PRODUCTS, including pasteurized or otherwise processed milk, excluding low fat dairy products.

0.3 PPM

FISH Smoked, frozen, canned
SHELLFISH,, Smoked, frozen, canned

LINDANE

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

0.3 PPM (ON FAT BASIS)

BUTTER

OTHER MANUFACTURED DAIRY PRODUCTS, including pasteurized or otherwise processed milk, excluding low fat dairy products.

MALATHION
(CFR 121.228 and 121.1172)

Be certain there is no appreciable time lapse between sampling-analysis and seizure referral. If several days have elapsed since the original sampling then resampling is required.

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL - CITATION

60 PPM

CITRUS PULP

10 PPM

RAISINS

METHOXYCHLOR

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

1.5 PPM (ON FAT BASIS)

BUTTER

OTHER MANUFACTURED DAIRY PRODUCTS, including pasteurized or otherwise processed milk, excluding low fat dairy products.

METHOXYCHLOR

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

1.5 PPM (ON FAT BASIS)

BUTTER

OTHER MANUFACTURED DAIRY PRODUCTS, including pasteurized or otherwise processed milk, excluding low fat dairy products.

Commodity Code: 00

PRODUCT: Raw Agricultural Commodities

PROBLEM: Adulteration - Pesticide Residues

REMARKS

Direct seizure referral to General Counsel or referral to DRC with a recommendation for legal action is authorized where both the original and check analysis show pesticide residues at or above the criteria specified in this Guideline. Both the original and check analysis must be confirmed by an appropriate identification method such as thin layer chromatography.

Referral to DRC is authorized where both the original and check analysis exceed the legal tolerance but do not meet or exceed the administrative guideline, provided sampling and analytical techniques are adequate to prove conclusively that the legal tolerance has been exceeded. In such case all analytical data including work sheets should be submitted along with the recommendation for action.

The criteria herein are not directly applicable to any combinations of pesticides except those specifically noted (e.g. dieldrin and aldrin, etc.).

If any other combinations of any of the pesticides in this guideline are encountered and the pesticides are covered by finite published tolerances, calculate the percentage of tolerance as shown in 40 CFR 180.3(c)(1) except substitute the criteria in the Guideline for the published tolerance. If the resultant figure exceeds 100% the sample may be referred to the Division of Regulatory Guidance with a recommendation for legal action.

However, because tolerances for negligible residues generally replace clearances on a no-residue basis, residues within tolerances designated as negligible residues shall not be considered in the calculation of the total percentage of tolerances to determine compliance with 40 CFR 180.3.

The criteria specified in the Guideline have been set to allow for variance in analytical results. This Guideline will be reviewed periodically and revised as necessary.

The criteria specified in the Guideline apply to objective samples. This does not limit or prohibit recommending legal action to the Division of Regulatory Guidance on lower residue levels if there is evidence of misuse of pesticides, or if some other factor appears to warrant action.

Where a criterion for action is shown for a general category of raw agricultural commodity covered by 40 CFR 180.1(h) that criterion applies to the corresponding specific commodities shown in that paragraph (e.g., if an action level is shown for "beans" this level applies to green beans, lima beans, navy beans, etc.).

The criteria in this Guideline are given in parts per million on the commodity "as-is" unless otherwise specifically noted. Under the criteria for direct reference seizure to General Counsel-citation, the sample to be examined for pesticide residues will consist of the whole raw agricultural commodity, except where otherwise specified in the tolerance for the pesticide in question or where otherwise specified in 40 CFR 180.1(j)

The criteria for referral to the Division of Regulatory Guidance with a recommendation for legal action are based on samples examined as shown below and recommendations for legal action must clearly indicate the exact portion of the food used for analysis:

EGGS: Discard shells, examine combined yolks and whites.

FRUITS:

(1) General Comment; remove and discard stems.

(2) PINEAPPLE; remove and discard crown and flowers (outer protective petals), examine edible portion only.

(3) MELONS; remove and discard rind, stem and seeds, examine edible portion only.

(4) STRAWBERRIES: remove and discard caps.

(5) APRICOTS, PEACHES, CHERRIES, PLUMS, etc; remove and discard stones or pits.

(6) MANGOES; remove and discard rind and stone.

FISH (RAW): Remove and discard heads, scales and guts, examine remainder including tails if present.

SHELLFISH (RAW):

(1) CLAMS AND OYSTERS: examine a homogeneous mixture of meats and liquor.

(2) SHRIMP AND SIMILAR SHELLFISH; remove and discard heads, tails and shell, examine edible meat only.

VEGETABLES:

(1) General Comment; ROOT CROPS; rinse lightly to remove adhering soil.

(2) SWEET CORN; remove and discard husks and cob, examine kernels.

(3) PUMPKINS; remove and discard rind, stem, and seeds, examine edible portion.

NOTE: The original screening analysis can be made on the sample as received ("as is") if it is found that this saves time.

However, when residues are encountered over the criteria levels the sample must be re-assayed on the portion specified above and check analysis must also be done on the portion specified if the re-assay confirms residues over the criteria level.

SPECIMEN CHARGE FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL RAW AGRICULTURAL PRODUCTS

Article adulterated when introduced into and while in interstate commerce within meaning of 21 U. S. C. 342(a)(2)(B) in that it is a raw agricultural commodity and it contains a pesticide chemical, namely, dieldrin, which is unsafe within meaning of 21 U. S. C. 346(a) since the quantity of such pesticide chemical on apples is not within the limits of the tolerance so prescribed by regulations promulgated pursuant of 21 U. S. C. 346a(b).

RECEIVED 8 MAY 1974 REGISTRATION DIVISION PESTICIDES

INDEX

Pesticide	Attachment
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METHOXYCHLOR	L
PARATHION & METHYL PARATHION	M
PERTHANE	N
TDE	O
TOXAPHENE	P

8 MAY 1974

ALDRIN & DIELDRIN
(40 CFR 180.135 and 180.37)

The figures below are for the above pesticides individually or in combination. However, in adding amounts of dieldrin and aldrin do not count dieldrin or aldrin found at a level below 0.03 PPM. for fruits and vegetables, and grains, or 0.3 PPM. (on a fat basis) for milk

ALDRIN & DIELDRIN

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

0.15 PPM

APPLES	EGGPLANT	PLUMS (FRESH PRUNES)
APRICOTS	GRAPES	POTATOES
ASPARAGUS	HORSERADISH	PUMPKINS
BANANAS	LETTUCE	QUINCES
BROCCOLI	MANGOES	RADISHES
BRUSSELS SPROUTS	MUSKMELONS	RADISH TOPS
CABBAGE	NECTARINES	SALSIFY ROOTS
CANTALOUPS	ONIONS	STRAWBERRIES
CARROTS	PARSNIPS	SUMMER SQUASH
CAULIFLOWER	PEACHES	SWEET POTATOES
CELERY	PEARS	TOMATOES
CHERRIES	PEPPERS	WATERMELONS
CRANBERRIES	PIMENTOS	WINTER SQUASH
CUCUMBERS	PINEAPPLE	

0.15 PPM

BARLEY STRAW	RICE STRAW	WHEAT STRAW
OAT STRAW	RYE STRAW	

0.08 PPM

RICE GRAIN

0.05 PPM

BARLEY GRAIN	RYE GRAIN	WHEAT GRAIN
OAT GRAIN		

8 MAY 1974
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Dieldrin & Aldrin - Continued

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

0.3 PPM
FISH AND SHELLFISH (RAW EDIBLE PORTION ONLY)

0.3 PPM
(ON FAT BASIS) MILK (RAW, UNPASTEURIZED)

0.08 PPM
CITRUS FRUITS

0.15
MELONS (THOSE NOT OTHERWISE LISTED)

0.05 PPM

FRUITS

BLACKBERRIES
BLUEBERRIES
BOYSENBERRIES
CURRANTS
DEWBERRIES
ELDERBERRIES
FIGS
GOOSEBERRIES
HUCKLEBERRIES
LOGANBERRIES
RASPBERRIES

VEGETABLES

ARTICHOKES
BEANS
BLACK-EYED PEAS
COLLARDS
CORN (FRESH SWEET)
COWPEAS
ENDIVE (ESCAROLE)
GARDEN BEETS
GARDEN BEET TOPS
GARLIC
KALE
KOHLRABI
LEEKS
MUSTARD GREENS
PEANUTS
PEAS
RUTABAGAS
SALSIFY TOPS
SHALLOTS
SOY BEANS
SPINACH
SWISS CHARD
TURNIPS
TURNIPS TOPS

0.03 PPM

EGGS
ALFALFA
CLOVER
CORN FORAGE
CORN GRAIN
COWPEA HAY
GRAIN SORGHUM
GRAIN SORGHUM
FORAGE
LESPEDEZA
PEA HAY
PEANUT HAY
POPCORN
SOY BEAN HAY
HAY (ALL OTHERS)

D D C.
40 CFR 180.140

The figures below are to be used for total DDC. However, in adding amounts of individual isomers do not count alpha, gamma or delta DDC at a level below 0.1 ppm in milk or eggs and below 0.02 in other products. Do not count beta DDC at a level below 0.2 in milk or eggs and below 0.04 in other products.

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

1.2 PPM

FRUITS

APPLES
APRICOTS
CHERRIES
GRAPES
MELONS
NECTARINES
PEACHES
PEARS
PLUMS
STRAWBERRIES

VEGETABLES

ASPARAGUS
BROCCOLI
BRUSSELS SPROUTS
CABBAGE
CAULIFLOWER
CELERY
COLLARDS
CUCUMBERS
EGGPLANT
KALE
KOHLRABI
LETTUCE
MUSTARD GREENS
OKRA
ONIONS (DRY BULB)
PEPPERS
PUMPKINS
SPINACH
SQUASH
SUMMER SQUASH
SWISS CHARD
TOMATOES

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

1.2 PPM

AVOCADO

0.3 PPM (ON FAT BASIS)

MILK (RAW, UNPASTEURIZED)

0.5 PPM

EGGS

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B H C - CONTINUED

0.5 PPM

FRUITS

BLACKBERRIES
BLUEBERRIES
BOYSENBERRIES
CITRUS FRUIT
CRANBERRIES
CURRANTS
DEWBERRIES
ELDERBERRIES
FIGS
GOOSEBERRIES
GUAVAS
HUCKLEBERRIES
LOGANBERRIES
MANGOES
PINEAPPLES
QUINCES
RASPBERRIES

VEGETABLES

ARTICHOKES
BEANS
BEETS
CARROTS
CORN (FRESH SWEET)
ENDIVE
PEAS
POTATOES
RADISHES
RUTABAGAS
SWEET POTATOES
TURNIPS
TURNIP GREENS OR TOPS

0.1 PPM

GRAINS

BARLEY
MILO (SORGHUMS)
CORN GRAIN
OATS
RICE
RYE
WHEAT
MAYS

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CARBARYL
(40 CFR 180.169)

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

110 PPM

VEGETABLES

SUGARBEET TOPS

FORAGE

ALFALFA
ALFALFA HAY
BARLEY STRAW
BARLEY (GREEN FODDER)
BEAN FORAGE
BEAN HAY
CLOVER
CLOVER HAY
CORN FODDER
CORN FORAGE
COTTON FORAGE
COWPEA FORAGE
COWPEA HAY
GRASSES
GRASSHAY
OAT STRAW
OATS GREEN FODDER
PEANUT HAY
PEA VINES
RICE STRAW
RYE STRAW
RYE GREEN FODDER
SOYBEAN FORAGE
SOYBEAN HAY
SORGHUM FORAGE
WHEAT STRAW
WHEAT GREEN FODDER

14 PPM

FRUITS

BLACKBERRIES
BOYSENBERRIES
DEWBERRIES
LOGANBERRIES
RASPBERRIES

VEGETABLES

BEET GREENS OR TOPS
COLLARDS
DANDELION
KALE
MUSTARD GREENS
PARSLEY
SPINACH
SWISS CHARD
TURNIP GREENS OR TOPS

11 PPM

FRUITS

APPLES
APRICOTS
BANANAS
BLUEBERRIES
CHERRIES
CRANBERRIES
GRAPES
MELONS
NECTARINES
OLIVES
PEACHES
PEARS
PLUMS
STRAWBERRIES

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Carbaryl - Continued

11 PPM - Cont'd

VEGETABLES

ASPARAGUS	CHINESE CABBAGE	PEAS (WITH PODS)
BEANS	CUCUMBERS	PEPPERS
BROCCOLI	EGGPLANT	PUMPKINS
BRUSSELS SPROUTS	ENDIVE (ESCAROLE)	SALSIFY TOPS
CABBAGE	KOHLRABI	SUMMER SQUASH
CARROTS	LETTUCE	TOMATOES
CAULIFLOWER	OKRA	WINTER SQUASH

GRAINS

MILO (SORGHUMS)

6 PPM

BEETS (GARDEN) ROOTS	COWPEAS	RUTABAGAS
CORN, FRESH SWEET	HORSERADISH	SALSIFY ROOTS
(KERNELS PLUS COB	PARSNIPS	SOYBEANS
WITH HUSK REMOVED)	RADISHES	TURNIPS (ROOTS)
COTTONSEED	RICE, GRAIN	

CRITERIA FOR RECOMMENDING LEAGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

11 PPM

CITRUS FRUIT

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CHLORDANE
(40 CFR 180.122)

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

0.4 PPM

FRUITS

APPLES
APRICOTS
BLACKBERRIES
BLUEBERRIES
BOYSENBERRIES
CHERRIES
CITRUS FRUIT
DEWBERRIES
GRAPES
LOGANBERRIES
MELONS
NECTARINES
PAPAYAS
PEACHES
PEARS
PINEAPPLES
PLUMS
QUINCES
RASPBERRIES
STRAWBERRIES
YOUNGBERRIES

VEGETABLES

BEANS
BEETS (GARDEN)
BEET GREENS OR TOPS
BROCCOLI
BRUSSEL SPROUTS
CABBAGE
CARROTS
CAULIFLOWER
CELERY
COLLARDS
CORN (FRESH SWEET)
CUCUMBERS
EGGPLANT
KALE
KOHLRABI
LETTUCE
OKRA
ONIONS
PEAS
PEPPERS
POTATOES
RADISHES
RADISH TOPS
RUTABAGAS
RUTABAGAS TOPS
SQUASH
SUMMER SQUASH
SWEET POTATOES
TOMATOES
TURNIPS
TURNIP GREENS OR TOPS

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DDT
(40 CFR 180.147)

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

7.7 PPM

FRUITS

APPLES	GRAPES	PEACHES
APRICOTS	MANGOES	PEARS
BLUEBERRIES (HUCKLEBERRIES)	MELONS	PINEAPPLES
CRANBERRIES	NECTARINES	QUINCES

VEGETABLES

BEANS	MUSTARD GREENS	SPINACH
BEET GREENS	OKRA	SQUASH
CABBAGE	ONIONS	SUMMER SQUASH
CELERY	PARSNIP GREENS	SWEET POTATOES
COLLARDS	PEAS	SWISS CHARD
CUCUMBERS	PEPPERS	TOMATOES
EGG PLANTS	PUMPKINS	TURNIP GREENS
KALE	RADISH TOPS	
LETTUCE	RUTABAGA TOPS	

4.4 PPM COTTON SEED

3.9 PPM

FRUITS

CHERRIES PLUMS (FRESH PRUNES)

VEGETABLES

CARROTS SWEET CORN (KERNEL PLUS COB WITH HUSK REMOVED)

1.7 PPM SOYBEANS (DRY FORM)

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1.2 PPM

FRUITS

BLACKBERRIES
BOYSENBERRIES
CURRANTS
DEWBERRIES
GOOSEBERRIES
GUAVAS
LOGANBERRIES
RASPBERRIES
STRAWBERRIES
YOUNGBERRIES

1.2 PPM

VEGETABLES

ARTICHOKES
ASPARAGUS
BEETS (ROOTS)
BROCCOLI
BRUSSELS SPROUTS
CAULIFLOWER
ENDIVE (ESCAROLE)
KOHLRABI
MUSHROOMS
PARSNIPS (ROOTS)
POTATOES
RADISHES (ROOTS)
RUTABAGAS (ROOTS)
TURNIPS (ROOTS)

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

3.9 PPM

CITRUS FRUITS
AVOCADOS
PAPAYAS

1.2 PPM

PEANUTS

8 MAY 1974

DDT, DDE AND TDE
(40 CFR 180.147c)

Individually or in combination. However, in adding amounts of DDT, DDE and TDE do not count any of the three found below 0.3 ppm. (on a fat basis) for milk or 0.2 ppm. for eggs, hay and grain.

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

1.5 PPM (ON FAT BASIS)

MILK (RAW, UNPASTEURIZED)

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

1.5 PPM EGGS

0.5 PPM HAY

GRAINS: CORN GRAIN, BARLEY, MILO (SORGHUM), OATS, RICE, RYE, WHEAT

8 MAY 1974
REGISTRATION DIVISION
PESTICIDES, EPA

GUIDELINE | 7320.09 | ATTACHMENT 6

ENDRIN
(40 CFR 180.131)

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

0.3 PPM (ON FAT BASIS) MILK (RAW, UNPASTEURIZED)

0.3 PPM FISH & SHELLFISH (RAW EDIBLE PORTION ONLY)

0.05 PPM

FRUITS

APPLES
APRICOTS
BLACKBERRIES
BLUEBERRIES
BOYSENBERRIES
CITRUS FRUIT
CHERRIES
CRANBERRIES
CURRANTS
DEWBERRIES
ELDERBERRIES
FIGS
GOOSEBERRIES
GRAPES
GUAVAS
HUCKLEBERRIES
LOGANBERRIES
MANGOES
MELONS
NECTARINES
PEACHES
PEARS
PINEAPPLES
PLUMS
QUINCES
RASPBERRIES
STRAWBERRIES

VEGETABLES

ARTICHOKES
ASPARAGUS
BEANS
BEETS
BROCCOLI
BRUSSEL SPROUTS
CABBAGE
CARROTS
CAULIFLOWER
COLLARDS
CORN (FRESH SWEET)
CUCUMBERS
EGGPLANT
ENDIVE
KALE
KOHLRABI
LETTUCE
MUSTARD GREENS
OKRA
ONIONS
PEAS
PEPPERS
PIMENTOS
POTATOES
PUMPKINS
RADISHES
RUTABAGAS
SQUASH
SPINACH
SUGARBEETS
SUGARBEET TOPS
SUMMER SQUASH
SWEET POTATOES
TOMATOES
TURNIPS
TURNIP GREENS
WINTER SQUASH

0.03 PPM EGGS

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HEPTACHLOR & HEPTACHLOR EPOXIDE
(40 CFR 180.104)

The figures below are for the above pesticides individually or in combination. However, do not count heptachlor or heptachlor epoxide found at a level below 0.3 ppm. (on a fat basis) for milk or 0.03 ppm. for other products.

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

0.15 PPM

CABBAGE	RUTABAGAS	SNAPBEANS
LETTUCE		

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

0.3 PPM (ON FAT BASIS) MILK (RAW, UNPASTEURIZED)

0.3 PPM FISH & SHELLFISH (RAW EDIBLE PORTION ONLY)

0.03 PPM

EGGS	MILO (SORGHUMS)	RYE
BARLEY	OATS	WHEAT
CORN GRAIN	RICE	ALL HAYS

0.05 PPM

FRUITS

APPLES	CURRANTS	MELONS
APRICOTS	DEWBERRIES	NECTARINES
BLACKBERRIES	ELDERBERRIES	PEACHES
BLUEBERRIES	FIGS	PEARS
BOYSENBERRIES	GOOSEBERRIES	PINEAPPLES
CITRUS FRUIT	GRAPES	PLUMS
CHERRIES	HUCKLEBERRIES	QUINCES
CRANBERRIES	LOGANBERRIES	RASPBERRIES
		STRAWBERRIES

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VEGETABLES

ARTICHOKES
ASPARAGUS
BEANS (EXCEPT SNAP BEANS)
BEETS
BLACKEYED PEAS
BROCCOLI
BRUSSEL SPROUTS
CARROTS
CAULIFLOWER
CELERY
COLLARDS
CORN (FRESH SWEET)
COWPEAS
CUCUMBERS
EGGPLANT
ENDIVE
KALE
KOHLRABI
LIMA BEANS
MUSTARD GREENS
OKRA
ONIONS
PARSELY
PEAS
PEPPERS
PIMENTOES
POTATOES
PUMPKINS
RADISHES
SQUASH
SPINACH
SUGARBEETS
SUGAR CANE
SUMMER SQUASH
SWISS CHARD
SWEET POTATOES
TOMATOES
TURNIPS
TURNIP GREENS OR TOPS
WINTER SQUASH

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1, 1-Bis (p-Chlorophenyl)-2,2,2, -trichloroethanol

(KELTHANE)
(40 CFR 180.163)

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

35 PPM HOPS

12 PPM

APRICOTS
NECTARINES
PEACHES

6.0 PPM

FRUITS

APPLES
BLACKBERRIES
BOYSENBERRIES
CANTALOUPS
CHERRIES
CRABAPPLES
DEWBERRIES
GRAPES
LOGANBERRIES
MELONS
MUSKMELONS
PEARS
PLUMS
QUINCES
RASPBERRIES
STRAWBERRIES
WATERMELONS

VEGETABLES

BEANS, DRY
BEANS, FRESH
CUCUMBERS
EGG PLANT
LIMA BEANS
PEPPERS
PIMENTOS
PUMPKINS
SNAP BEANS
SUMMER SQUASH
TOMATOES
WINTER SQUASH

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

12 PPM

GRAPEFRUITS
KUMQUATS
LEMONS
LIMES
ORANGES
TANGELOS
TANGERINES

6.0 PPM FIGS

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LINDANE
(40 CFR 180.133)

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

3.3 PPM

MELONS

VEGETABLES

CUCUMBERS
LETTUCE
MUSHROOMS
PUMPKINS
SQUASH
SUMMER SQUASH
TOMATOES

1.1 PPM

FRUITS

APPLES
APRICOTS
CHERRIES
GRAPES
GUAVAS
MANGOES
NECTARINES
PEACHES
PEARS
PINEAPPLES
PLUMS
QUINCES
STRAWBERRIES

VEGETABLES

ASPARAGUS
BROCCOLI
BRUSSEL SPROUTS
CABBAGE
CAULIFLOWER
CELERY
COLLARDS
EGGPLANT
KALE
KOHLRABI
MUSTARD GREENS
OKRA
ONIONS (DRY BULB)
PEPPERS
SPINACH
SWISS CHARD

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CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

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1.1 PPM

AVOCADO

0.5 PPM

FRUITS

BLACKBERRIES	CURRANTS	GOOSEBERRIES
BLUEBERRIES	DEWBERRIES	HUCKLEBERRIES
BOYSENBERRIES	ELDERBERRIES	LOGANBERRIES
CITRUS FRUIT	FIGS	RASPBERRIES
CRANBERRIES		

VEGETABLES

ARTICHOKES	ENDIVE	RUTABAGAS
BEANS	PEAS	SWEET POTATOES
BEETS (GARDEN)	POTATOES	TURNIPS
CARROTS	RADISHES	TURNIP GREENS
CORN (FRESH SWEET)		

0.5PPM

EGGS

0.3 PPM (ON FAT BASIS)

MILK (RAW, UNPASTEURIZED)

0.1 PPM

BARLEY	OATS	WHEAT
CORN GRAIN	RICE	HAYS
MILO (SORGHUMS)	RYE	

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MALATHION

(40 CFR 180.111)

Be certain there is no appreciable time lapse between sampling-analysis and seizure referral. If several days have elapsed since the original sampling then resampling is required.

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

160 PPM

ALFALFA
CLOVER
COWPEAS FORAGE AND HAY
GRASSES
GRASS HAY
LESPEDEZA HAY AND STRAW
LUPINE HAY AND STRAW
PEANUT FORAGE AND HAY
SOYBEAN FORAGE AND HAY
VETCH HAY AND STRAW

60 PPM

ALMOND HULLS

10 PPM

FRUITS

APPLES
APRICOTS
BLACKBERRIES
BLUEBERRIES
BOYSENBERRIES
CHERRIES
CRANBERRIES
CURRANTS
DEWBERRIES
GOOSEBERRIES
GRAPES
GUAVAS
LOGANBERRIES
MANGOS
MELONS
NECTARINES
PASSION FRUITS
PEACHES
PEARS
PINEAPPLES
PLUMS
PRUNES
QUINCES
RASPBERRIES
STRAWBERRIES

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VEGETABLES

ASPARAGUS	HORSERADISH	POTATOES
BEANS	KALE	PUMPKINS
BEETS (INCLUDING TOPS)	KOHLRABI	RADISHES
BROCCOLI	LEEKS	RUTABAGAS
BRUSSEL SPROUTS	LENTILS	SALSIFY (INCLUDING TOPS)
CABBAGE	LETTUCE	SHALLOTS
CARROTS	MUSHROOMS	SPINACH
CAULIFLOWER	MUSTARD GREENS	SQUASH
CELERY	OKRA	SUGAR BEETS (TOPS)
COLLARDS	ONIONS (INCLUDING GREEN ONIONS)	SUMMER SQUASH
CUCUMBERS		SWISS CHARD
DANDELION	PARSLEY	TOMATOES
EGGPLANT	PARSNIPS	TURNIPS (INCLUDING TOPS)
ENDIVE (ESCAROLE)	PEAS	WATERCRESS
GARLIC	PEPPERS	WINTER SQUASH

FORAGE

CORN FORAGE	PEA VINE HAY	PEA VINES
SORGHUM FORAGE		

GRAINS AND SEED

BARLEY	LUPINE SEED	RYE
CORN GRAIN	OATS	VETCH SEED
LESPEDEZA SEED	RICE	WHEAT
	SORGHUM	

2.4 PPM FRESH VEGETABLE SWEET CORN (KERNELS PLUS COB WITH HUSK REMOVED)

1.2 PPM

PAPAYAS	SUGAR BEETS (ROOTS)	SWEET POTATOES

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

10 PPM

AVOCADOS	LEMONS	PEANUTS
DATES	LIMES	PECANS
GRAPEFRUIT	PEPPERMINT	SOYBEANS
FIGS	ORANGES	TANGELOS
KUMQUATS	SPEARMINT	TANGERINES
		WALNUTS

8 MAY 197

CRITERIA (CONTINUED)

2.4 PPM

COTTONSEED

1.2 PPM

ALMONDS

CHESTNUTS
FILBERTS

MACADAMIA NUTS

0.6 PPM

MILK FAT

0.2 PPM

EGGS

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METHOXYCHLOR
(40 CFR 180.120)

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

110 PIH

ALFALFA
CLOVER
GRASS FOR FORAGE
SOYBEAN FORAGE
COWPEAS
PEANUT FORAGE

16 PIH

FRUITS

APPLES
APRICOTS
BLACKBERRIES
BLUEBERRIES
BOYSENBERRIES
CHERRIES
CRANBERRIES
CURRANTS
DEWBERRIES
GOOSEBERRIES
GRAPES
LOGANBERRIES
MELONS
NECTARINES
PEACHES
PEARS
PINEAPPLES
PLUMS
QUINCES
RASPBERRIES
STRAWBERRIES
YOUNGBERRIES

VEGETABLES

ASPARAGUS
BEANS
BEETS (GARDEN)
BEET GREENS OR TOPS
BROCCOLI
BRUSSEL SPROUTS
CABBAGE
CARROTS
CAULIFLOWER
COLLARDS
CORN (FRESH SWEET)
CUCUMBERS
EGGPLANT
KALE
KOHLRABI
LETTUCE
MUSHROOMS
PEAS
PEPPERS
PUMPKINS
RADISHES
RADISH TOPS
RUTABAGAS
RUTABAGAS TOPS
SQUASH
SPINACH
SUMMER SQUASH
TOMATOES
TURNIPS
TURNIP GREENS OR TOPS

2.2 PIH

GRAINS

BARLEY
CORN GRAIN
MILO (SORGHUM)
OATS
RICE
RYE
WHEAT

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VEGETABLES (Continued)

1.1 PPM

POTATOES SWEET POTATOES YAMS

CRITERIA FOR RECOMMENDING LEGAL ACTION TO THE DIVISION OF REGULATORY GUIDANCE

1.5 PPM (ON FAT BASIS)

MILK (RAW, UNPASTEURIZED)

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DDT
(40 CFR 180.147)

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

7.7 PPM

FRUITS

APPLES	GRAPES	PEACHES
APRICOTS	MANGOES	PEARS
BLUEBERRIES (HUCKLEBERRIES)	MELONS	PINEAPPLES
CRANBERRIES	NECTARINES	QUINCES

VEGETABLES

BEANS	MUSTARD GREENS	SPINACH
BEET GREENS	OKRA	SQUASH
CABBAGE	ONIONS	SUMMER SQUASH
CELERY	PARSNIP GREENS	SWEET POTATOES
COLLARDS	PEAS	SWISS CHARD
CUCUMBERS	PEPPERS	TOMATOES
EGG PLANTS	PUMPKINS	TURNIP GREENS
KALE	RADISH TOPS	
LETTUCE	RUTABAGA TOPS	

4.4 PPM COTTON SEED

3.9 PPM

FRUITS

CHERRIES PLUMS (FRESH PRUNES)

VEGETABLES

CARROTS SWEET CORN (KERNEL PLUS COB WITH HUSK REMOVED)

1.7 PPM SOYBEANS (DRY FORM)

RECEIVED
8 MAY 1974
REGISTRATION DIVISION
PESTICIDES EPA

1.2 PPM

FRUITS

BLACKBERRIES	DEWBERRIES	RASPBERRIES
BOYSENBERRIES	GOOSEBERRIES	STRAWBERRIES
CURRANTS	GUAVAS	YOUNGBERRIES
	LOGANBERRIES	

1.2 PPM

VEGETABLES

ARTICHOKES	CAULIFLOWER	POTATOES
ASPARAGUS	ENDIVE (ESCAROLE)	RADISHES (ROOTS)
BEETS (ROOTS)	KOHLRABI	RUTABAGAS (ROOTS)
BROCCOLI	MUSHROOMS	TURNIPS (ROOTS)
BRUSSELS SPROUTS	PARSNIPS (ROOTS)	

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

3.9 PPM

CITRUS FRUITS	AVOCADOS	PAPAYAS

1.2 PPM

PEANUTS

8 MAY 1974

DDT, DDE AND TDE
(40 CFR 180.147c)

Individually or in combination. However, in adding amounts of DDT, DDE and TDE do not count any of the three found below 0.3 ppm. (on a fat basis) for milk or 0.2 ppm. for eggs, hay and grain.

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

1.5 PPM (ON FAT BASIS)

MILK (RAW, UNPASTEURIZED)

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

1.5 PPM EGGS

0.5 PPM HAY

GRAINS: CORN GRAIN, BARLEY, MILO (SORGHUM), OATS, RICE, RYE, WHEAT

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GUIDELINE 7320.09 ATTACHMENT G

ENDRIN
(40 CFR 180.131)

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CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

0.3 PPM (ON FAT BASIS) MILK (RAW, UNPASTEURIZED)

0.3 PPM FISH & SHELLFISH (RAW EDIBLE PORTION ONLY)

0.05 PPM

FRUITS

APPLES
APRICOTS
BLACKBERRIES
BLUEBERRIES
BOYSENBERRIES
CITRUS FRUIT
CHERRIES
CRANBERRIES
CURRANTS
DEWBERRIES
ELDERBERRIES
FIGS
GOOSEBERRIES
GRAPES
GUAVAS
HUCKLEBERRIES
LOGANBERRIES
MANGOES
MELONS
NECTARINES
PEACHES
PEARS
PINEAPPLES
PLUMS
QUINCES
RASPBERRIES
STRAWBERRIES

VEGETABLES

ARTICHOKES
ASPARAGUS
BEANS
BEETS
BROCCOLI
BRUSSEL SPROUTS
CABBAGE
CARROTS
CAULIFLOWER
COLLARDS
CORN (FRESH SWEET)
CUCUMBERS
EGGPLANT
ENDIVE
KALE
KOHLRABI
LETTUCE
MUSTARD GREENS
OKRA
ONIONS
PEAS
PEPPERS
PIMENTOS
POTATOES
PUMPKINS
RADISHES
RUTABAGAS
SQUASH
SPINACH
SUGARBEETS
SUGARBEET TOPS
SUMMER SQUASH
SWEET POTATOES
TOMATOES
TURNIPS
TURNIP GREENS
WINTER SQUASH

0.03 PPM EGGS

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HEPTACHLOR & HEPTACHLOR EPOXIDE
(40 CFR 180.104)

The figures below are for the above pesticides individually or in combination. However, do not count heptachlor or heptachlor epoxide found at a level below 0.3 ppm. (on a fat basis) for milk or 0.03 ppm. for other products.

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

0.15 PPM

CABBAGE	RUTABAGAS	SNAPBEANS
LETTUCE		

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

0.3 PPM (ON FAT BASIS) MILK (RAW, UNPASTEURIZED)

0.3 PPM FISH & SHELLFISH (RAW EDIBLE PORTION ONLY)

0.03 PPM

EGGS	MILO (SORGHUMS)	RYE
BARLEY	OATS	WHEAT
CORN GRAIN	RICE	ALL HAYS

0.05 PPM

FRUITS

APPLES	CURRANTS	MELONS
APRICOTS	DEWBERRIES	NECTARINES
BLACKBERRIES	ELDERBERRIES	PEACHES
BLUEBERRIES	FIGS	PEARS
BOYSENBERRIES	GOOSEBERRIES	PINEAPPLES
CITRUS FRUIT	GRAPES	PLUMS
CHERRIES	HUCKLEBERRIES	QUINCES
CRANBERRIES	LOGANBERRIES	RASPBERRIES
		STRAWBERRIES

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VEGETABLES

ARTICHOKES
ASPARAGUS
BEANS (EXCEPT SNAP BEANS)
BEETS
BLACKEYED PEAS
BROCCOLI
BRUSSEL SPROUTS
CARROTS
CAULIFLOWER
CELERY
COLLARDS
CORN (FRESH SWEET)
COWPEAS
CUCUMBERS
EGGPLANT
ENDIVE
KALE
KOHLRABI
LIMA BEANS
MUSTARD GREENS
OKRA
ONIONS
PARSELY
PEAS
PEPPERS
PIMENTOES
POTATOES
PUMPKINS
RADISHES
SQUASH
SPINACH
SUGARBEETS
SUGAR CANE
SUMMER SQUASH
SWISS CHARD
SWEET POTATOES
TOMATOES
TURNIPS
TURNIP GREENS OR TOPS
WINTER SQUASH

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GUIDELINE 7420.09 ATTACHMENT I

1, 1-Bis (p-Chlorophenyl)-2,2,2, -trichloroethanol

(KELTHANE)
(40 CFR 180.163)

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CRITERIA FOR DIRECT REFERRAL SEIZURE TO GENERAL COUNSEL-CITATION

35 PPM HOPS

12 PPM

APRICOTS NECTARINES PEACHES

6.0 PPM

FRUITS

APPLES
BLACKBERRIES
BOYSENBERRIES
CANTALOUPS
CHERRIES
CRABAPPLES
DEWBERRIES
GRAPES
LOGANBERRIES
MELONS
MUSKMELONS
PEARS
PLUMS
QUINCES
RASPBERRIES
STRAWBERRIES
WATERMELONS

VEGETABLES

BEANS, DRY
BEANS, FRESH
CUCUMBERS
EGG PLANT
LIMA BEANS
PEPPERS
PIMENTOS
PUMPKINS
SNAP BEANS
SUMMER SQUASH
TOMATOES
WINTER SQUASH

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

12 PPM

GRAPEFRUITS
KUMQUATS
LEMONS
LIMES
ORANGES
TANGELOS
TANGERINES

6.0 PPM FIGS

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LINDANE
(40 CFR 180.133)

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

3.3 PPM

MELONS

VEGETABLES

CUCUMBERS
LETTUCE
MUSHROOMS
PUMPKINS
SQUASH
SUMMER SQUASH
TOMATOES

1.1 PPM

FRUITS

APPLES
APRICOTS
CHERRIES
GRAPES
GUAVAS
MANGOES
NECTARINES
PEACHES
PEARS
PINEAPPLES
PLUMS
QUINCES
STRAWBERRIES

VEGETABLES

ASPARAGUS
BROCCOLI
BRUSSEL SPROUTS
CABBAGE
CAULIFLOWER
CELERY
COLLARDS
EGGPLANT
KALE
KOHLRABI
MUSTARD GREENS
OKRA
ONIONS (DRY BULB)
PEPPERS
SPINACH
SWISS CHARD

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CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

1.1 PPM

AVOCADO

0.5 PPM

FRUITS

BLACKBERRIES	CURRANTS	GOOSEBERRIES
BLUEBERRIES	DEWBERRIES	HUCKLEBERRIES
BOYSENBERRIES	ELDERBERRIES	LOGANBERRIES
CITRUS FRUIT	FIGS	RASPBERRIES
CRANBERRIES		

VEGETABLES

ARTICHOKES	ENDIVE	RUTABAGAS
BEANS	PEAS	SWEET POTATOES
BEETS (GARDEN)	POTATOES	TURNIPS
CARROTS	RADISHES	TURNIP GREENS
CORN (FRESH SWEET)		

0.5PPM

EGGS

0.3 PPM (ON FAT BASIS)

MILK (RAW, UNPASTEURIZED)

0.1 PPM

BARLEY	OATS	WHEAT
CORN GRAIN	RICE	HAYS
MILO (SORGHUMS)	RYE	

MALATHION

(40 CFR 180.111)

Be certain there is no appreciable time lapse between sampling-analysis and seizure referral. If several days have elapsed since the original sampling then resampling is required.

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

160 PPM

ALFALFA
CLOVER
COWPEAS FORAGE AND HAY
GRASSES
GRASS HAY
LESPEDEZA HAY AND STRAW
LUPINE HAY AND STRAW
PEANUT FORAGE AND HAY
SOYBEAN FORAGE AND HAY
VETCH HAY AND STRAW

60 PPM

ALMOND HULLS

10 PPM

FRUITS

APPLES
APRICOTS
BLACKBERRIES
BLUEBERRIES
BOYSENBERRIES
CHERRIES
CRANBERRIES
CURRANTS
DEWBERRIES
GOOSEBERRIES
GRAPES
GUAVAS
LOGANBERRIES
MANGOS
MELONS
NECTARINES
PASSION FRUITS
PEACHES
PEARS
PINEAPPLES
PLUMS
PRUNES
QUINCES
RASPBERRIES
STRAWBERRIES

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VEGETABLES

ASPARAGUS	HORSERADISH	POTATOES
BEANS	KALE	PUMPKINS
BEETS (INCLUDING TOPS)	KOHLRABI	RADISHES
BROCCOLI	LEEKS	RUTABAGAS
BRUSSEL SPROUTS	LENTILS	SALSIFY (INCLUDING TOPS)
CABBAGE	LETTUCE	SHALLOTS
CARROTS	MUSHROOMS	SPINACH
CAULIFLOWER	MUSTARD GREENS	SQUASH
CELERY	OKRA	SUGAR BEETS (TOPS)
COLLARDS	ONIONS (INCLUDING GREEN ONIONS)	SUMMER SQUASH
CUCUMBERS		SWISS CHARD
DANDELION	PARSLEY	TOMATOES
EGGPLANT	PARSNIPS	TURNIPS (INCLUDING TOPS)
ENDIVE (ESCAROLE)	PEAS	WATERCRESS
GARLIC	PEPPERS	WINTER SQUASH

FORAGE

CORN FORAGE	PEA VINE HAY	PEA VINES
SORGHUM FORAGE		

GRAINS AND SEED

BARLEY	LUPINE SEED	RYE
CORN GRAIN	OATS	VETCH SEED
LESPEDEZA SEED	RICE	WHEAT
	SORGHUM	

2.4 PPM FRESH VEGETABLE SWEET CORN (KERNELS PLUS COB WITH HUSK REMOVED)

1.2 PPM

PAPAYAS	SUGAR BEETS (ROOTS)	SWEET POTATOES

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

10 PPM

AVOCADOS	LEMONS	PEANUTS
DATES	LIMES	PECANS
GRAPEFRUIT	PEPPERMINT	SOYBEANS
FIGS	ORANGES	TANGELOS
KUMQUATS	SPEARMINT	TANGERINES
		WALNUTS

8 MAY 197

CRITERIA (CONTINUED)

2.4 PPM

COTTONSEED

1.2 PPM

ALMONDS

CHESTNUTS
FILBERTS

MACADAMIA NUTS

0.6 PPM

MILK FAT

0.2 PPM

EGGS

METHOXYCHLOR
(40 CFR 180.120)

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

110 PIH

ALFALFA	CLOVER	GRASS FOR FORAGE
SOYBEAN FORAGE	COWPEAS	PEANUT FORAGE

16 PIH

FRUITS

APPLES	CURRANTS	PEACHES
APRICOTS	DEWBERRIES	PEARS
BLACKBERRIES	GOOSEBERRIES	PINEAPPLES
BLUEBERRIES	GRAPES	PLUMS
BOYSENBERRIES	LOGANBERRIES	QUINCES
CHERRIES	MELONS	RASPBERRIES
CRANBERRIES	NECTARINES	STRAWBERRIES
		YOUNGBERRIES

VEGETABLES

ASPARAGUS	CORN (FRESH SWEET)	RADISHES
BEANS	CUCUMBERS	RADISH TOPS
BEETS (GARDEN)	EGGPLANT	RUTABAGAS
BEET GREENS OR TOPS	KALE	RUTABAGAS TOPS
BROCCOLI	KOHLRABI	SQUASH
BRUSSEL SPROUTS	LETTUCE	SPINACH
CABBAGE	MUSHROOMS	SUMMER SQUASH
CARROTS	PEAS	TOMATOES
CAULIFLOWER	PEPPERS	TURNIPS
COLLARDS	PUMPKINS	TURNIP GREENS OR TOPS

2.2 PIH

GRAINS

BARLEY	MILO (SORGHUM)	RICE
CORN GRAIN	OATS	RYE
		WHEAT

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VEGETABLES (Continued)

1.1 PPM

POTATOES SWEET POTATOES YAMS

CRITERIA FOR RECOMMENDING LEGAL ACTION TO THE DIVISION OF REGULATORY GUIDANCE

1.5 PPM (OF FAT BASIS)

MILK (RAW, UNPASTEURIZED)

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GUIDELINE | 7320.09 | ATTACHMENT

PARATHION & METHYL PARATHION

(40 CFR 180.121)

The figures below are for the above pesticides individually or in combination. However, in adding amounts of parathion and methyl parathion, do not count parathion or methyl parathion found at a level of below 0.05 ppm.

Be certain there is no appreciable time lapse between sampling-analysis and seizure referral. If several days have elapsed since the original sampling then resampling is required.

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

1.2 PIM

FRUITS

APPLES
APRICOTS
BLACKBERRIES
BLUEBERRIES (HUCKLEBERRIES)
BOYSENBERRIES
CHERRIES
CRANBERRIES
CURRANTS
DEWBERRIES
GOOSEBERRIES
GRAPES
GUAVAS
LOGANBERRIES
MANGOES
MELONS
NECTARINES
OLIVES
PEACHES
PEARS
PINEAPPLES
PLUMS
QUINCES
RASPBERRIES
STRAWBERRIES
YOUNGBERRIES

VEGETABLES

ARTICHOKES
BEANS
BEETS
BEET GREENS
BROCCOLI
BRUSSELS SPROUTS
CABBAGE
CARROTS
CAULIFLOWER
CELERY
COLLARDS
CORN (FRESH SWEET)
CUCUMBERS
EGGPLANT
ENDIVE (ESCAROLE)
GARLIC
KALE
KOHLRABI
LETTUCE
MUSTARD GREENS
OKRA
ONIONS
PARSNIPS (W/OR W/O TOPS)
PARSNIP TOPS
PEAS
PEPPERS
PUMPKINS
RADISHES
RADISH TOPS
RUTABAGAS
RUTABAGA TOPS
SPINACH
SQUASH
SUMMER SQUASH
SWISS CHARD
TOMATOES
TURNIPS
TURNIP GREENS OR TOPS

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GUIDELINE 7420.09 ATTACHMENT

FORAGE

ALFALFA	CORN FORAGE	PEA FORAGE
CLOVER	GRASS FORAGE	VETCH

GRAINS

BARLEY	RICE
OATS	WHEAT

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

0.3 PPM

SUNFLOWER SEED

1.2 PPM

AVOCADO	DATES	HOPS
CITRUS FRUIT	FIGS	PEANUTS

GUIDELINE 7470.09 ATTACHMENT Y

PERTHANE
(40 CFR 180.139)

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CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

13 PEM

FRUITS

APPLES	CHERRIES	PEARS

VEGETABLES

BROCCOLI	CABBAGE	LETTUCE
BRUSSELS SPROUTS	CAULIFLOWER	SPINACH
	KOHLRABI	

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TDE
(40 CFR 180.187)

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

7.7 PPM

FRUITS

APPLES	GRAPES	PEACHES
APRICOTS	MELONS	PEARS
BLUEBERRIES	NECTARINES	QUINCES

VEGETABLES

BEANS	PUMPKINS	SUMMER SQUASH
CUCUMBERS	RUTABAGAS TOPS	TOMATOES
EGGPLANT	SQUASH	TURNIP GREENS OR TOPS
PEPPERS		

3.9 PPM

FRUITS

BLACKBERRIES	DEWBERRIES	RASPBERRIES
BOYSENBERRIES	LOGANBERRIES	STRAWBERRIES
CHERRIES	PLUMS (FRESH PRUNES)	

CORN, FRESH SWEET (KERNELS PLUS COB WITH HUSKS REMOVED)

1.1 PPM

BROCCOLI	CAULIFLOWER	RUTABAGAS (ROOTS)
BRUSSELS SPROUTS	KOHLRABI	SPINACH
CABBAGE	LETTUCE	TURNIPS (ROOTS)
CARROTS	PEAS	

CRITERIA FOR RECOMMENDING LEGAL ACTION TO DIVISION OF REGULATORY GUIDANCE

3.9 PPM

CITRUS FRUIT

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GUIDELINE | 7420.09 | ATTACHMENT F

TOXAPHENE
(40 CFR 180.138)

CRITERIA FOR DIRECT REFERENCE SEIZURE TO GENERAL COUNSEL-CITATION

8.5 PPM

FRUITS

APPLES	DEWBERRIES	QUINCES
APRICOTS	LOGANBERRIES	RASPBERRIES
BLACKBERRIES	NECTARINES	STRAWBERRIES
BOYSENBERRIES	PEACHES	YOUNGBERRIES
CRANBERRIES	PEARS	

VEGETABLES

BEANS	CUCUMBERS	PARSNIPS
BROCCOLI	EGGPLANT	PEAS
BRUSSEL SPROUTS	HORSERADISH	PEPPERS
CABBAGE	KALE	PIMENTOES
CARROTS	KOHLRABI	RADISHES
CAULIFLOWER	LETTUCE	RADISH TOPS
CELERY	OKRA	RUTABAGAS
COLLARDS	ONIONS	SPINACH
CORN (FRESH SWEET)		TOMATOES

6 PPM

GRAINS

BARLEY	OATS	WHEAT
COTTONSEED	RICE	
MILO (SORGHUMS)	RYE	

3.5 PPM

BANANAS	PINEAPPLES

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CRITERIA FOR RECOMMENDING LEGAL ACTION TO THE DIVISION OF REGULATORY GUIDANCE

8.5 PPM

CITRUS FRUIT

5.0 PPM

FISH (RAW EDIBLE PORTION ONLY)

2.5 PPM

SOYBEANS

1.0 PPM

FRUITS

BLUEBERRIES	FIGS	MELONS
CHERRIES	GRAPES	PLUMS
CURRANTS		

VEGETABLES

ARTICHOKES	POTATOES	SWEET POTATOES
ASPARAGUS	PUMPKINS	TURNIPS
BEETS	SQUASH	TURNIP GREENS OR TOPS
MUSTARD GREENS	SUMMER SQUASH	WINTER SQUASH

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PESTICIDE	ACTION LEVEL
Heptachlor	0.03 ppm
Heptachlor Epoxide	0.03 ppm

These actionllevels apply to objective samples. This does not limit or prohibit recommending legal action on lower residue levels if there is evidence of misuse of pesticides or some other factor appears to warrant action.

Samples showing significant residues of pesticides other than these above should be discussed with the Division of Compliance, Bureau of Veterinary Medicine (VM-220)

FOOD AND DRUG ADMINISTRATION
ADMINISTRATIVE GUIDELINES MANUAL

GUIDELINE 7426.04

CHAPTER 74 - ANIMAL FEEDS

Commodity Code: 33

PRODUCT: Processed Animal Feeds

PROBLEM: Pesticide Residues

CRITERIA FOR RECOMMENDING LEGAL ACTION TO THE DIVISION OF COMPLIANCE

Actionable where both the original and check analysis show pesticide residue at or above the action level specified unless such residues are within tolerances established on the source raw agricultural commodity from which the feed was derived. Some examples of such tolerances are for DDT - 1.5 ppm on soybeans and 7 ppm on various fruits and vegetables; for TDE - 7 ppm on various fruits and vegetables; for Kelthane - 10 ppm on citrus fruit and 5 ppm on various vegetables; for Toxaphene - 7 ppm on various fruit and vegetables and 5 ppm on various grains; for BHC - 5 ppm on various fruits and vegetables; and for Lindane - 10 ppm on various fruits and vegetables. Both original and check analysis must be confirmed by an appropriate identification method such as thin layer chromatography.

PESTICIDE		ACTION LEVEL
DDT, DDE and TDE (individual or in combination). (However, in adding amounts of DDT, DDE, & TDE do not count any of the three found below 0.2 ppm.)		0.5 ppm
Kelthane		0.5 ppm
Toxaphene		0.5 ppm
BHC		0.1 ppm
Lindane		0.1 ppm
Dieldrin)	Except that the action level on sugar beet pulp is 0.1 ppm and this must be taken into account on any feed derived in whole or in part from sugar beet pulp.	0.03 ppm
Aldrin)		0.03 ppm
Endrin		0.03 ppm

8 MAY 1974

ORIGINATOR: Division of Compliance, Bureau of Veterinary Medicine (VM-300)